29 1962

UGUST
1962

75 CENTS

# ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

AMES FILE
COPY No. 2

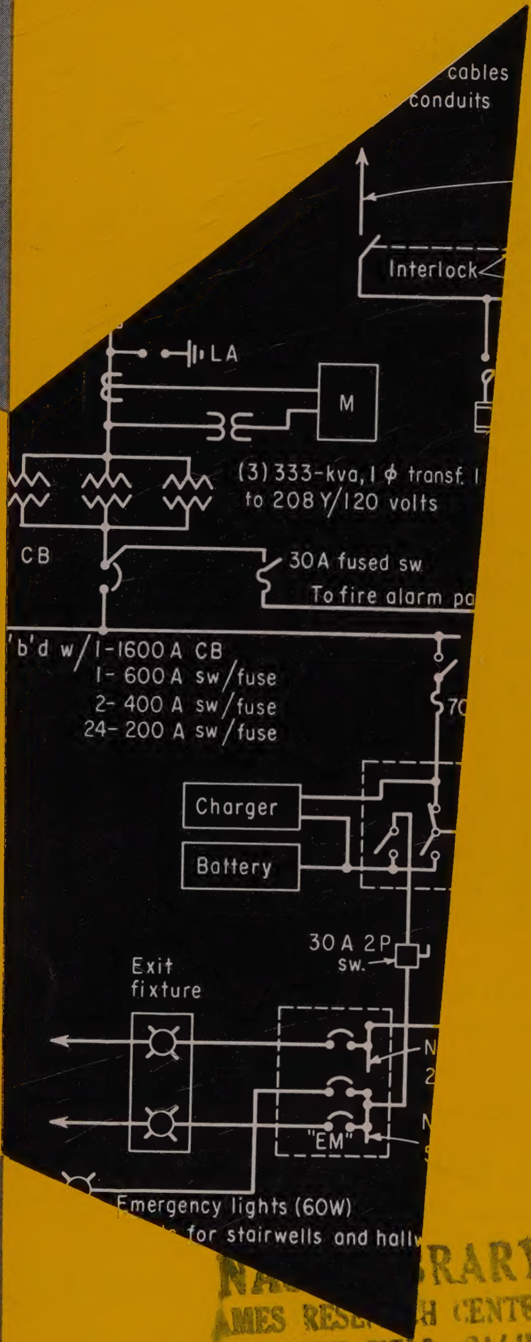
## MAJOR 1962 NATIONAL ELECTRICAL CODE CHANGES

---

## EFFECTIVE MOTOR BEARING MAINTENANCE

---

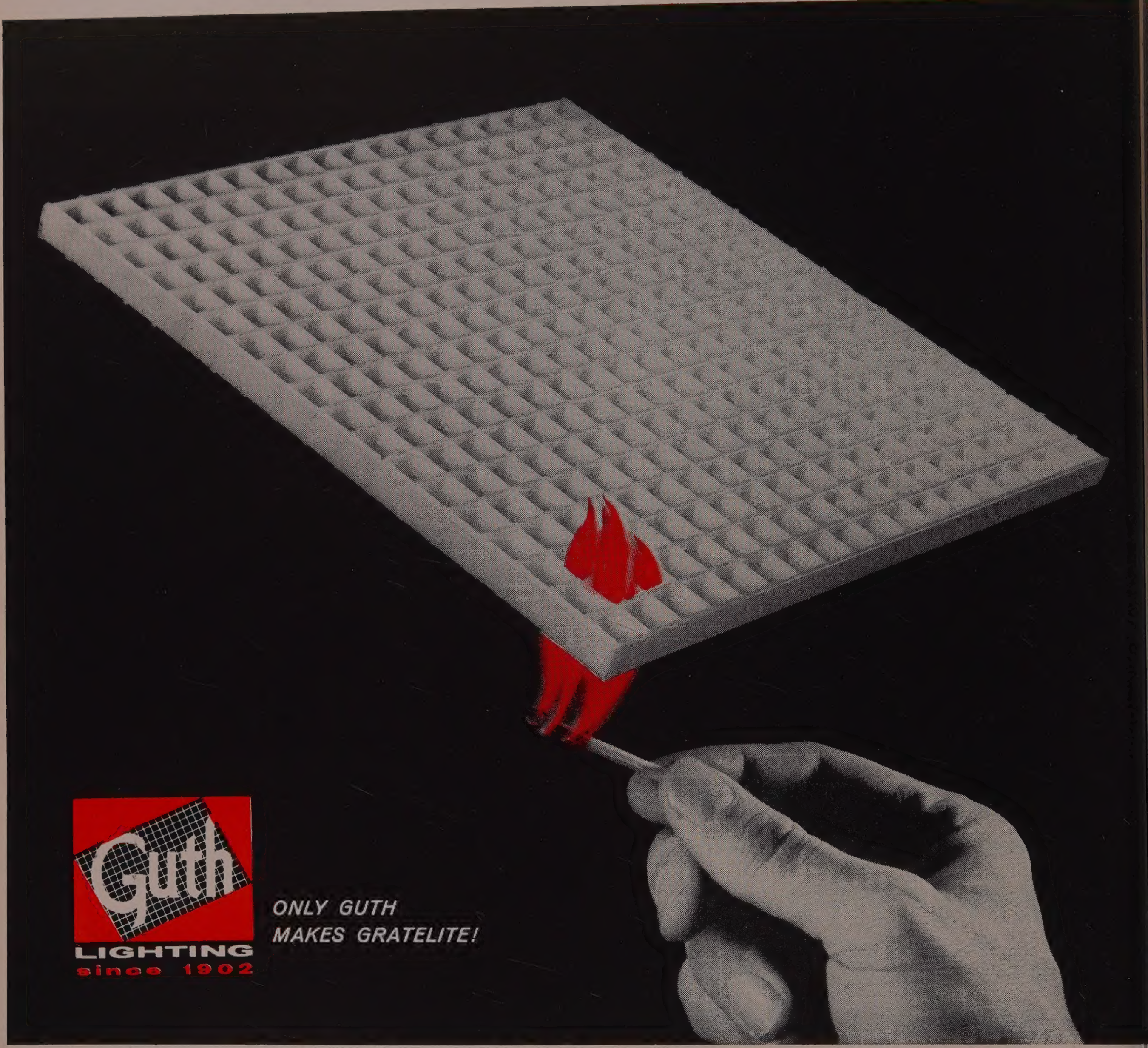
## PRIMARIES UNDER SIDEWALKS



NASA LIBRARY
AMES RESEARCH CENTER
MOFFETT FIELD, CALIF.

A McGRAW-HILL PUBLICATION | 61ST YEAR

# n. c. gratelite offers all the advantages of a louver diffuser plus it's NON-COMBUSTIBLE



Guth N.C. (for Non-Combustible) Gratelite Louver Diffusers(1) are molded of non-combustible plastic—listed by Underwriters Laboratories, Inc. as NON-COMBUSTIBLE with a low 25 U.L. flamespread rating.

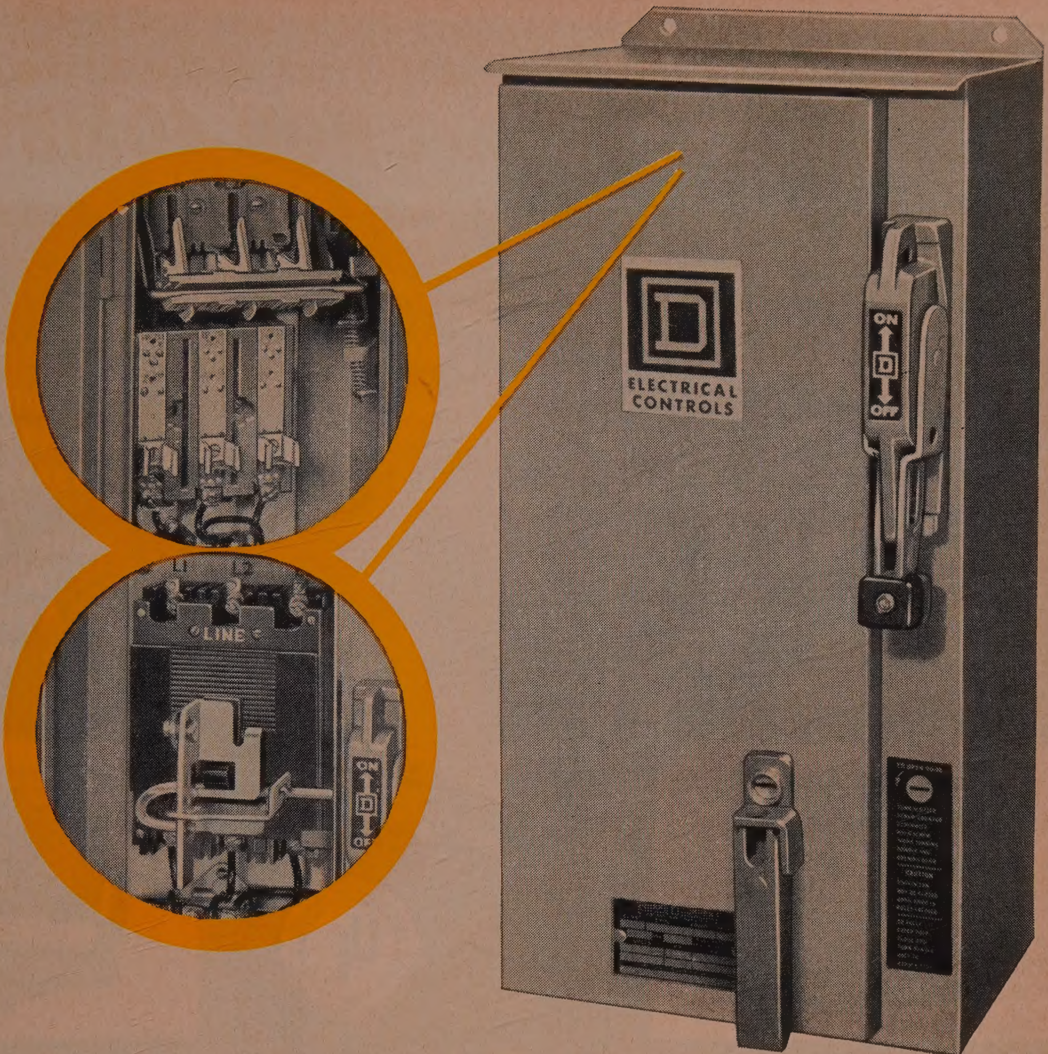
Supported by Guth Una-Tee System, N.C. Gratelite in overall electric ceilings can't fall out and cause panic. Also, building insurance rates may be substantially reduced with N.C. Gratelite Illuminated Ceilings.

N.C. Gratelites feature built-in breathing action fo complete flow of air through open ⅜″ cubes—fixture and lamps operate cooler; dust, bugs and dirt dro through. Sprinkler systems, heating and air condition ing ducts can be mounted above open ⅜″ cubes Supreme rigidity of N.C. Gratelites minimizes chanc of buckling, sagging and warping in ceilings. Plus, N.C Gratelite is non-electrostatic—repels dust and dirt fo easier maintenance. N.C. plastic is light stabilized.

***write today for our N.C. GRATELITE brochure***

**THE EDWIN F. GUTH COMPANY, 2615 WASHINGTON BOULEVARD, ST. LOUIS 77, MISSOUR**

(1) LISTED BY U.L. ® U.S. PAT. NO. 2,745,001, CAN. PAT. NO. 538,245



NOW!

Both SWITCH *and* BREAKER types!

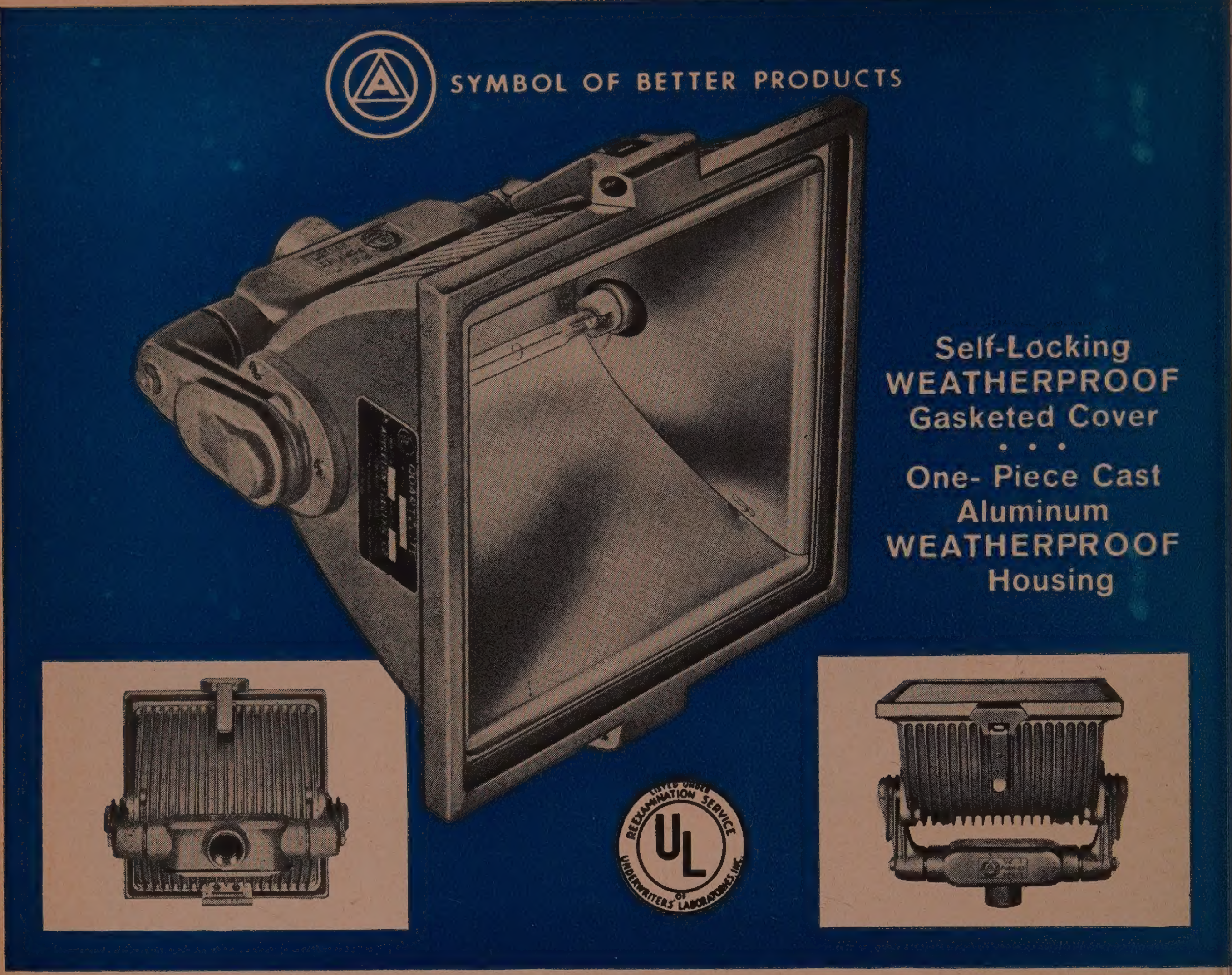
*PLUS*

*all the features that make the*
*Square D combination starter*
***THE SAFEST OF ALL!***

**GET THE FULL STORY!** Write for Bulletin SM-292 to find out why Square D starters are so safe, so reliable, so easy to use. Square D Company, Dept. SA,
4041 North Richards Street, Milwaukee 12, Wisconsin.

SQUARE D COMPANY

*wherever electricity is distributed and controlled*


SYMBOL OF BETTER PRODUCTS
Self-Locking WEATHERPROOF Gasketed Cover
• • •
One- Piece Cast Aluminum WEATHERPROOF Housing
LISTED UNDER REEXAMINATION SERVICE
UL
UNDERWRITERS' LABORATORIES, INC.

# ALL NEW—ALL DIFFERENT

## the finest Quartzlite 500 You Can Buy!

This Appleton Quartzlite 500 utilizing the powerful 500 watt Quartz-Iodine Lamp, stands out above all others on the market. It has exclusive features found in no other unit and is engineered to give more trouble-free service outdoors or in, than ever before possible.

**HERE'S WHY!**

The new Appleton Quartzlite 500 has an exclusive one-piece cast aluminum housing heavily finned for heat dissipation and exceptional rigidity. A new weatherproof self-locking cover is fitted with a special one-piece moulded silicone rubber gasket that will prevent the entrance of moisture even if the latch should be left open, or jolted open by accident.

Mounting may be made directly to ¾″ rigid conduit because of the compact, light weight design and construction. Three efficient beam spreads are available: wide, medium and narrow.

Your Appleton Franchised Distributor will give you all the details. Call him for immediate service.

**APPLETON ELECTRIC COMPANY**
1701 Wellington Avenue
Chicago 13, Illinois

# APPLETON®

ELECTRICAL
CONSTRUCTION
AND MAINTENANCE

with which is consolidated Electrical Contracting, The Electragist and Electrical Record . . . Established 1901

Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management in the field of electrical construction and maintenance.

61ST YEAR • AUGUST 1962

**Sidelights** . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7

**Washington Report** . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9

**Dynamic Floodlighting, *An Editorial*** . . . . . . . . . . . . . . . . . . . . . . . . . . . . 73

**Highlights of the 1962 National Electrical Code** . . . . . . . . . . . . . . . . . . . . . 75
By J. H. WATT—A review of the major code revisions that should influence new design and installation techniques for wiring, devices and utilization equipment.

**Primaries Under Sidewalks** . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 83
Unusual precast concrete troughs distribute primary power through Northwest community development. Buried conduits extend to customers' premises. Located parallel to streets and set flush with ground, continuous cover sections also serve as sidewalks.

**115-KW Load in Residence** . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 86
By J. F. McPARTLAND—No compromise was made in the electrification of this 3-bedroom, one-story home in New Jersey. And the owners attest to the highest order of living comfort and convenience, with operating cost running under the design estimated value.

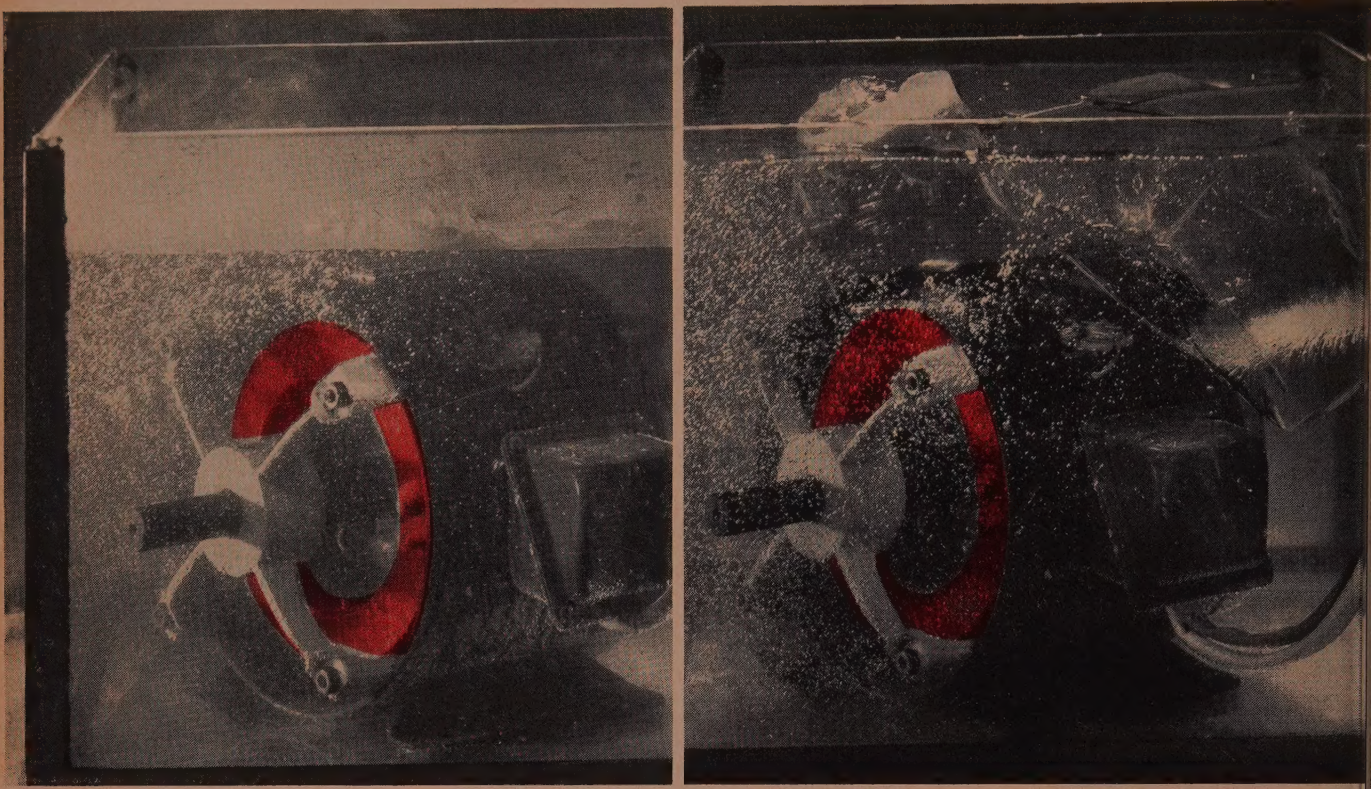
**Mercury Units Improve Floodlighting Efficiency** . . . . . . . . . . . . . . . . . . . . . . 88
New mercury floodlights on Ford Rotunda in Dearborn, Mich., provide 45 lumens per watt for old incandescent units which they replaced.

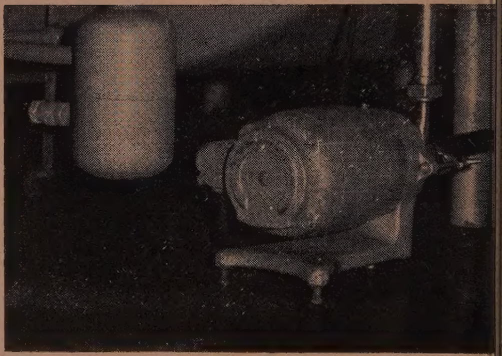
**Estimating Forum—XXII** . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 90
By RAY ASHLEY—Analyzing reported costs of proposed projects—Part 1.

**Electric Heating Forum** . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 92
Heating With Infrared.

**SILICONE NEWS from Dow Corning**

# Upgrade motor enclosures





## Specify Silastic RTV encapsulation for longer service life from motors

For motors in *hot* water — in *cold* water — in *any environment* that causes frequent failure — encapsulation with Silastic® RTV silicone rubber offers superior protection for windings . . . multiplies motor life.

***Take a tip*** from a midwest dairy. Subjected to daily equipment washdowns, a milk-pump drive-motor failed monthly. Then the windings were encapsulated with Silastic RTV . . . and failures ended. That was nearly two years ago! Motor life was multiplied twenty times and more.

***Silastic RTV*** is resilient — expands and contracts with the windings and laminations — won't crack or craze even during rapid thermal cycling. Silastic RTV remains rubbery over the wide temperature range of —70 to 180 C. Windings *stay sealed* in the protective jacket that's impervious to moisture, abrasive dusts and corrosive atmospheres.

***Specify encapsulation*** with Silastic RTV to upgrade enclosures on your class A, B, F or H motors. This protection is available from nearly two hundred motor service shops throughout the nation. They identify themselves with the emblem at right.

first in silicones
DOW CORNING
SILICONE-INSULATION
AUTHORIZED SERVICE SHOP
★

---

For a list of these shops, and more information about Silastic RTV encapsulated motors, write Dow Corning Corporation, Dept. 3108, Midland, Michigan.

first in silicones **Dow Corning**

# ELECTRICAL CONSTRUCTION AND MAINTENANCE

**AUGUST • 1962** continued

**Effective Motor Bearing Maintenance** .............. 96

Here's how a plant electrical department applies modern bearing maintenance techniques to obtain long-life motor service.

**Practical Methods** ............................ 103

All-electric concept for refrigerated warehouse; ground detection on high-voltage feed; DP switches solve wiring problem.

**Reader Service** ................................ 119

Product news announcements; catalogs and bulletins.

**Reader's Quiz** ................................ 145

Questions and answers on multiple neutral grounding; treating insulation boards; Faraday shield.

**Code Forum** ................................ 151

Answers to code questions on well casing as grounding electrode; air conditioning and electric heating; number of conductors in wireways and gutters; fuse reducers; overcurrent protection for panelboards; installation of UF cable; series lighting system.

**In the News** ................................ 161

**Dates Ahead** ................................ 167

**Among the Manufacturers** ...................... 167

**W. T. STUART**, *Editor*
**Alice McMullen**, *Managing Editor*
*Associate Editors*
**Berlon C. Cooper**, *New York*
**August Eckel**, *Chicago*
**J. F. McPartland**, *New York*
**W. J. Novak**, *New York*
**Hugh P. Scott**, *San Francisco*
**John H. Watt**, *New York*
*Art Editor*
**L. E. Devendorf**
*Assistant Editor*
**R. J. Lawrie**
*Editorial Assistant*
**Mary A. Corich**
*Consulting Editors*
**Ray Ashley**, *Chicago*
**John C. Hewitt**, *Olympia, Wash.*
**R. L. Lloyd**, *Washington, D. C.*
**B. Z. Segall**, *New Orleans*
**R. E. Ward**, *Nashville*
**Douglas Greenwald**, *Man., Economic Services*
**George B. Bryant, Jr.**, *Chief Correspondent, Washington Bureau*
**John Wilhelm**, *Manager, News Bureaus*

**W. W. GAREY**, *Publisher*

**A. L. De Weerdt**, *Circulation Manager*
**W. C. Carmichael**, *Business Manager*
**Ann P. Barrett**, *Production Manager*

**R. A. Hubley**, *Advertising Sales Manager*
**A. B. Conklin**, *New York*
**E. P. Gardner**, *New York*
**A. E. French, Jr.**, *Philadelphia*
**F. J. Seiler**, *Cleveland*
**J. E. Lange**, *Detroit*
**H. E. Green, Jr.**, *Chicago*
**R. R. Ream**, *Chicago*
**John Hernan**, *San Francisco*
**F. E. Le Beau**, *Dallas*
**D. O. Hanson**, *Houston*
**R. S. McGinnis**, *Los Angeles*
**R. H. Powell**, *Atlanta*
**Scott Hubbard**, *Portland*

Member of
AUDIT BUREAU OF CIRCULATIONS and
ASSOCIATED BUSINESS PUBLICATIONS

Vol. 61, No. 8 ELECTRICAL CONSTRUCTION and MAINTENANCE AUGUST 1962

Published monthly with an additional issue in September by McGraw-Hill Publishing Company, Inc. James H. McGraw (1860-1948), Founder. Executive, Editorial, Circulation and Advertising Offices: **McGraw-Hill Building, 330 W. 42nd St., New York 36, N.Y.** Printed in Albany, N.Y. **Officers of the Publications Division:** Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator, Daniel F. Crowley, Vice President and Controller. **Officers of the Corporation:** Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

This publication is available only by paid subscriptions which are solicited from persons engaged in electrical construction, maintenance or consulting services. The publisher reserves the right to refuse subscription service to others. **Position and company connection must be indicated on subscription orders.**

United States subscription rate for individuals in the field of the publication $3.00 a year. This issue 75 cents. Electrical Products Guide $2.50. Canada $5.00 a year. All other countries, $25.00 a year, payable in advance. Second class postage paid at Albany, N. Y., and at additional mailing offices. Printed in U.S.A. Title registered in U.S. Patent Office.

© Copyrighted 1962 by McGraw-Hill Publishing Co., Inc. — All rights reserved.

**UNCONDITIONAL GUARANTEE:** Subscription service may be discontinued at any time on written request by the subscriber. The publisher will refund the part of the subscription price applying to the remaining unfilled portion of the subscription.

SUBSCRIPTION: Send subscription correspondence and change of address to Subscription Manager, Electrical Construction and Maintenance, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Subscription Manager promptly of any change of address, giving old as well as new address, and including postal zone number, if any. If possible, enclose an address label from a recent issue of the magazine. Please allow one month for change to become effective.

Postmaster . . . Please send form 3579 to Electrical Construction and Maintenance, 330 West 42nd St., New York 36, N. Y.

# We offer
# –Quality Equipment
# –Complete Selection
# –Prompt Delivery

(ACTION FIXTURES IN STOCK)

# AND STILL ANOTHER TOOL TO HELP YOU SELL LIGHTING...

# TIME SALES AND LEASING!

Now Graybar makes it easier for you to get your share of the profitable lighting modernization market–through Time Sales and Leasing plans. Large initial capital outlays by your customers are eliminated and you get full payment at once. Our plans cover the full line of equipment in the big Graybar Lighting Action Program, plus wiring and other Graybar supplies, and your installation costs! Yet, there's nothing extra for you to do – Graybar handles all details. Let Graybar show you how Time Sales and Leasing may help you get your share of the profitable lighting market. It's another reason to call your nearby Graybar office – for everything electrical. Graybar Electric Co., Inc.: local service to contractors – coast to coast.

Graybar Electric Company, Inc.
420 Lexington Avenue
New York 17, N. Y.

Please send:

☐ Details on Time Sales and Leased Lighting.

☐ The Sales Kit for the Graybar Lighting Action Plan.

Name____________________
Company____________________
Title____________________
Address____________________
City__________Zone____State________

GraybaR

690

# Sidelights

## EW CODE

The forthcoming 1962 edition of the National Electrical Code is scheduled to be issued next month (September). It will contain nearly 300 revisions of past rules and new rules. There are four new Articles and several completely revised Articles. Associate Editor John H. Watt has been following the development of the new code closely and has prepared a special report for our readers covering the most significant changes. His timely and authoritative study "Highlights of the 1962 National Electrical Code" leads our editorial feature section this month beginning on page 75.

## NDER SIDEWALK DISTRIBUTION

A novel system of precast concrete troughs with cover slabs forming the sidewalks of a community development near Seattle, Wash., eliminates pole lines and allows full accessibility to the primary cable distribution system. In view of the growing interest in poleless community planning, the under sidewalk installation by Industrial Electric of Seattle is a development of considerable importance in these times. The installation is described in "Primaries Under Sidewalks" beginning on page 83.

## 15-KW RESIDENCE

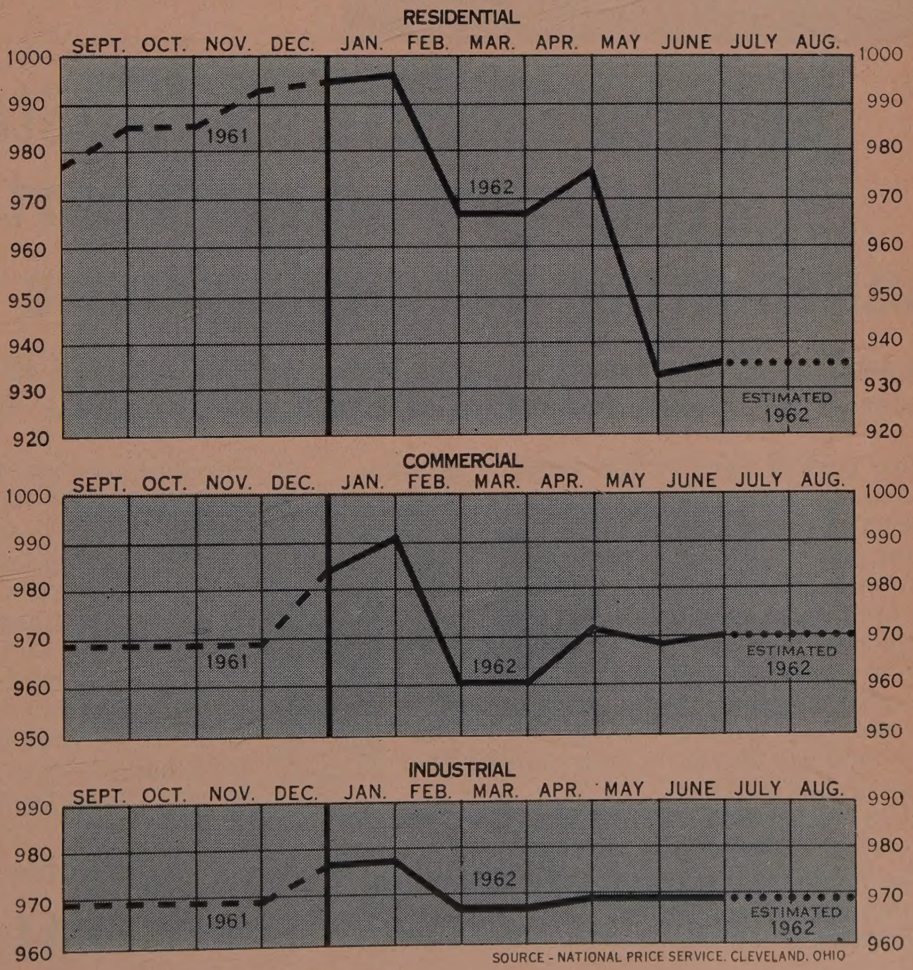
An all-electric home in New Jersey totals nearly 115 kw in connected load. The all-out, no-compromise electrification includes many features in high capacity wiring and equipment of wide interest to residential wiring contractors. Associate Editor J. F. McPartland reports on the installation in "115-KW Load in Residence" beginning on page 86.

## ELECTRICAL MATERIALS COST INDEX

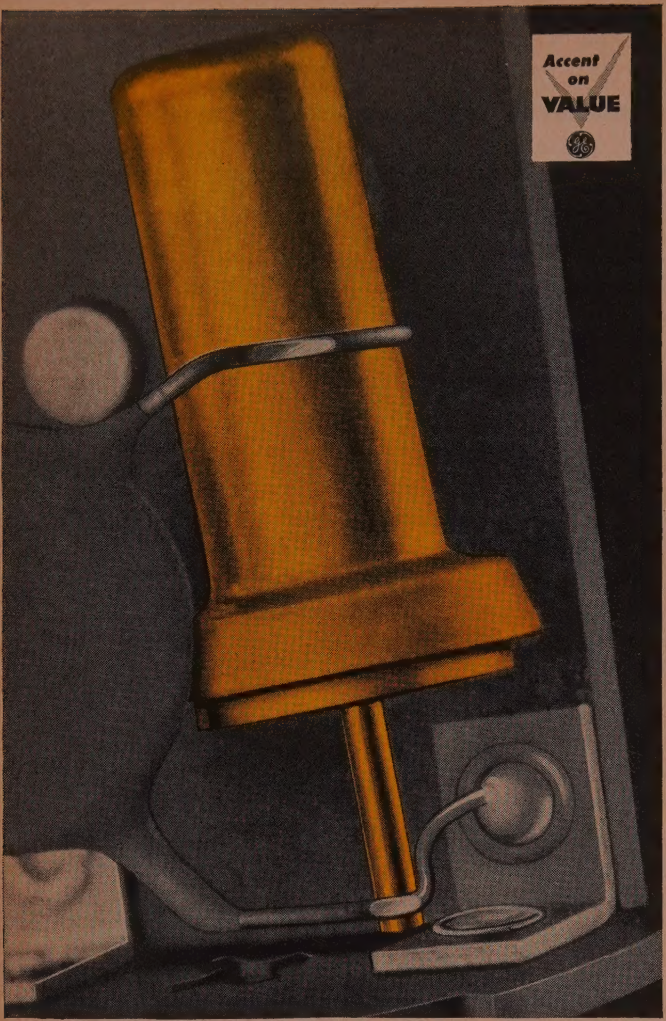
CHANGES IN THE COST OF ELECTRICAL MATERIALS FOR EACH OF THREE TYPICAL JOBS ARE SHOWN ON THESE THREE CHARTS.

THE BASE (1000) REPRESENTS THE AVERAGE COST OF THE MATERIALS FOR THE YEAR 1960

THE MONTHLY INDEX POINTS SHOW THE VARIATIONS IN COST ON THE FIRST OF EACH MONTH.

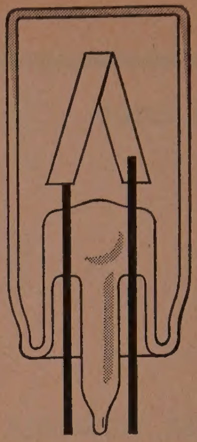


SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO



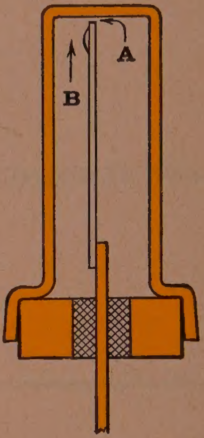
**Ordinary Glass Glow Switches**

— used in most FS-400 starters have inherent limitations due to the glass envelope. After adjustment has been made in the bimetal gap spacing, the glass must be sealed with intense heat that distorts the bimetal and destroys the accurate gap adjustment . . . precision cannot be achieved. Glass is fragile, subject to breakage under conditions of vibration or rough handling.



**New G-E Metal Glow Switches**

— use an accurately drawn steel shell welded to a preassembled base in a cool process where no heat is transmitted to the bimetal. Therefore more sensitive bimetal can be used and accurate gap spacings maintained. Close tolerance in small glow gap permits arc to strike instantly, loading the ballast to eliminate undesirable instant starting tendency.



# General Electric FS-400 Starter with new metal "heart" makes group relamping more practical

**This outstanding new metal glow switch, now furnished in G-E FS-400 Watch Dog* starters, establishes a new HIGH in precision performance . . . allows full realization of lamp life.**

This new type of glow switch employs an accurately-drawn steel shell enclosure, welded to a preassembled base in a cool process. In the manufacturing process, no heat is transmitted to the sensitive bimetal element; thus there is no distortion of the precise adjustment of the bimetal gap spacings. Such control is impossible to achieve in a glass glow switch.

The extra sensitive bimetal, together with a precise side gap spacing (B), predetermines accurate preheat timing . . . preconditions the lamp for proper starting.

These features, together with the precise, small, top gap (A), resist instant starting six times as much as all other FS-400 starters. Experience shows this increases lamp life. With the new G-E FS-400 metal glow switch starter, group relamping is now more practical than ever. The new General Electric FS-400 also offers these additional advantages over ordinary starters: elimination of annoying blinking lamps; up to 10 times longer starter life; longer life from ballasts.

You can put this latest General Electric innovation to work saving money and maintenance in the fluorescent lighting systems you service, by using new G-E FS-400 Watch Dog starters. Order from your G-E Distributor. For more information, write General Electric Company, Wiring Device Department, Providence 7, R. I.

**Registered Trademark of General Electric Company*

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

# Washington Report

AUGUST • 1962

**The national economy is still advancing,** but at a much slower pace. Gross national product in the second quarter was at a total annual rate of $552 billion, up $7 billion from the first quarter annual rate. This was well below the $12.3 billion increase in annual rate achieved during the second quarter of 1961, and far short of the $562 to $567 billion annual rate forecast by President Kennedy and his economists in January of this year.

The Federal government also wound up fiscal 1962 (as of June 30) with a budget deficit of $6.3 billion, which is another way of saying that part of this year's economic growth may be attributed to deficit financing by the government. The 1962 deficit followed a $3.9 billion deficit in fiscal 1961, and the current outlook is for another deficit in fiscal 1963, now getting under way, variously estimated at from $3 to $7 billion.

The current slowdown in economic growth is attributed partly to declining steel output, a change in inventory-buying policies by business during the second quarter, and an element of uncertainty as a result of the stock market's behavior during the summer months, and the possible impact of this uncertainty on spending plans by consumers and business.

**Several factors contributed to economic growth in the second quarter,** including construction spending, consumer spending, and a continuing high rate of Federal, state and local government spending. Also, total personal income was at a new high of $440.4 billion (seasonally adjusted annual rate) in June, employment reached a new record of 69,539,000 in mid-June, and total production was at an all-time record of 117.8% of the 1957 average. Overall, however, the increases were small, some only fractional, giving increasing evidence that consumers as well as businessmen are uneasy about the future.

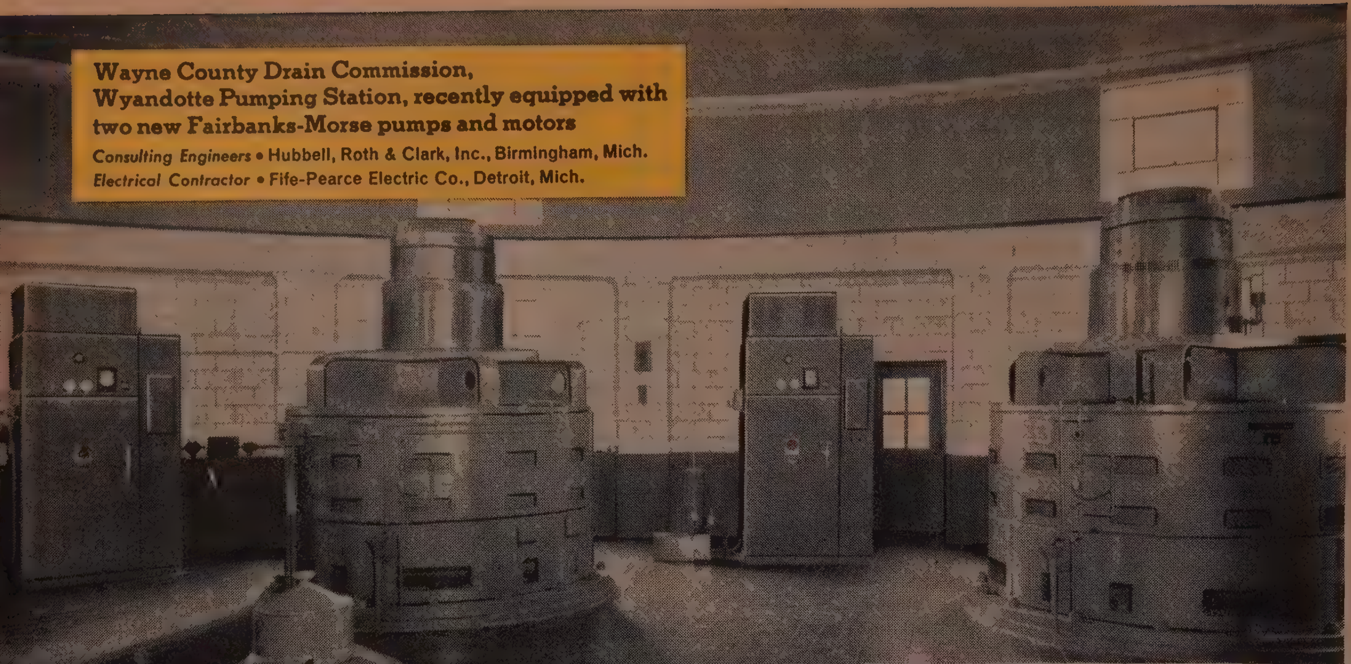
**New construction spending rose to a record for any month in June,** when dollar value climbed to a seasonally adjusted annual rate of $63 billion, or 11.4% of the 2nd quarter total economy. This was 4% higher than the May rate, and represented the fourth consecutive monthly increase. Actual spending totaled $5.8 billion, up 10% from the May total, and 10% above outlays in June of last year. Gains were registered in spending for private industrial and commercial buildings, farm structures and utility projects.

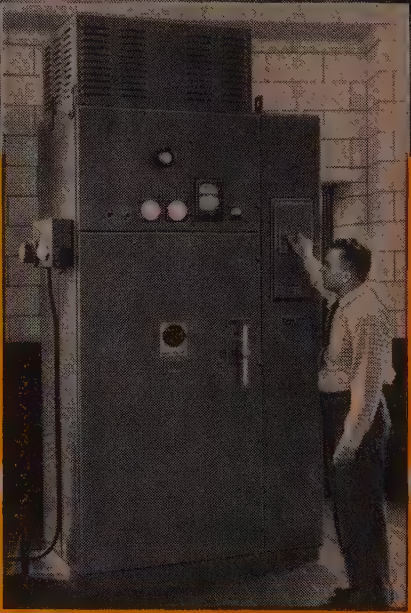
Department of Commerce officials also forecast early in July that new construction expenditures are expected to reach a record-breaking total of $60 billion in 1962, or about 6% more than the approximately $57 billion of 1961. Spending for new private housing and highways are expected to gain substantially over 1961, while small declines in outlays for private industrial and public educational structures, compared with 1961, are expected.

**Housing starts in June were off 11% from May,** for the first month-to-month decline since February. The seasonally adjusted annual rate was 1,389,000 units, while the actual number of farm and nonfarm homes started totaled 132,900 units. This is about the same as for June of last year. In its mid-year forecast for 1962 new construction, Department of Commerce estimated starts would total 1,475,000 units, up 11% from the 1961 level.

**Wayne County Drain Commission,**
**Wyandotte Pumping Station, recently equipped with two new Fairbanks-Morse pumps and motors**

*Consulting Engineers* • Hubbell, Roth & Clark, Inc., Birmingham, Mich.
*Electrical Contractor* • Fife-Pearce Electric Co., Detroit, Mich.





Certificate on File in Cleveland

# Certified Fault Protection WITHOUT FUSES!

## EC&M Fuseless Starters

## ELIMINATE FUSE PROBLEMS & COSTS

Now you can get full fault protection without the problems associated with fuses. EC&M's fuseless starters have certified interrupting capacities of 100,000 KVA at 2400 volts, 150,000 KVA at 4800 volts—an important consideration when starters were selected for the 1250-hp, 4800-volt starters at Wyandotte Pumping Station. This inherent fault protection is an EC&M "exclusive"—and is available with no first-cost premium.

EC&M starters are safe and easy to maintain. A three-way door interlock gives positive personnel protection, and an interlock is provided between the contactor and disconnect switch. Disconnect blades are visible in the open position when the door is open. No roll-out or draw-out needed for maintenance. All six contacts can be replaced without special tools in 10 minutes or so.

These cost-saving features make EC&M starters the logical choice for 2200-4800 volt motor drives.

### TYPICAL SAVINGS WITH EC&M STARTERS

| | Fused Starter | EC&M Fuseless Starter |
|---|---|---|
| Cost of 1250-hp 4800-volt Starter | $xxx.xx | Same as Fused Starter |
| Spare Fuse Costs: Set of 3 Spare Fuses for 1250 hp | $470.00 | 0 |

***SAVE** per starter, up to $500*
*(more on larger motors)*
*...with EC&M Fuseless Starters*

***Write** FOR DETAILS • Ask for Bulletin 8130*
*Square D Company, EC&M Division, 4500 Lee Road, Cleveland 28, Ohio*

**SQUARE D COMPANY**
EC&M DIVISION • CLEVELAND 28, OHIO
*wherever electricity is distributed and controlled*

6520

USES UNLIMITED!

ONLY ROCKER-GLO WITH SO MANY STYLES OFFERS THE UNUSUAL TOUCH FOR EVERY KIND OF BUILDING

Write Dept. ECM-862
PASS & SEYMOUR INC.
SYRACUSE 9, N. Y.
BOSTON CHICAGO LOS ANGELES SAN FRANCISCO
P&S

A-C
ALLIS CHALMERS
first switch-gear with static tripping
ALLIS-CHALMERS
STATIC OVER-CURRENT TRIP DEVICE
PICK-UP SETTINGS

# up to now you couldn't get this much distribution protection

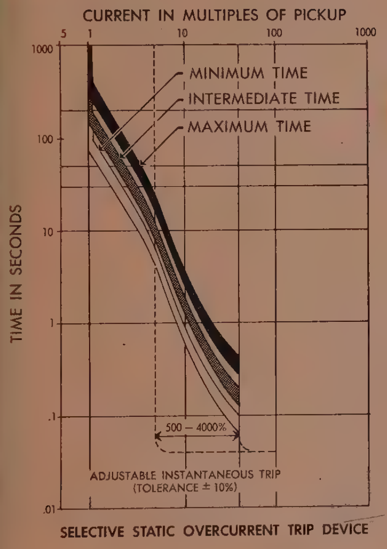
## What happens when a fresh, creative approach is applied to the design of 600-volt, metal-enclosed switchgear?

Many improvements result . . . among them, the first application of static overcurrent tripping to switchgear. Means more accurate current sensing, faster response, greater reliability . . . all at no extra cost.

Now you have continuous adjustment throughout the complete current range of each element. Choose either of two static overcurrent trip devices. Dual static trip device combines the long-time element and the instantaneous element. Or the versatile selective static trip device where a higher degree of coordination (delayed fault tripping) is required.

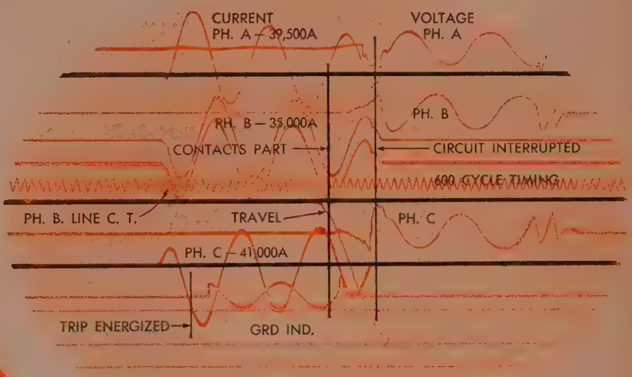
More A-C improvements: track-resistant, flame-retardant *Pyro-Shield* insulation is used throughout, coordinated to assure liberal creepage allowances. Breaker compartment located current transformers provide desirable front accessibility.

The new A-C 600-volt switchgear line is available in continuous current ratings through 4000 amperes and interrupting ratings through 150,000 amperes. *For more information, contact your nearby A-C representative or write Allis-Chalmers, Box 512, Milwaukee 1, Wisconsin.*

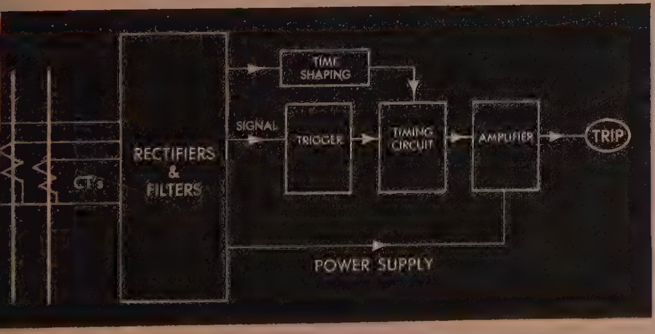


SELECTIVE STATIC OVERCURRENT TRIP DEVICE

More functional time current characteristics and reduced band widths permit better integration into the overall protective scheme.



Typical test oscillogram shows the outstanding performance of LA-600, 25,000-amp interrupting capacity breakers.



Simplified block diagram of low energy static overcurrent trip system.

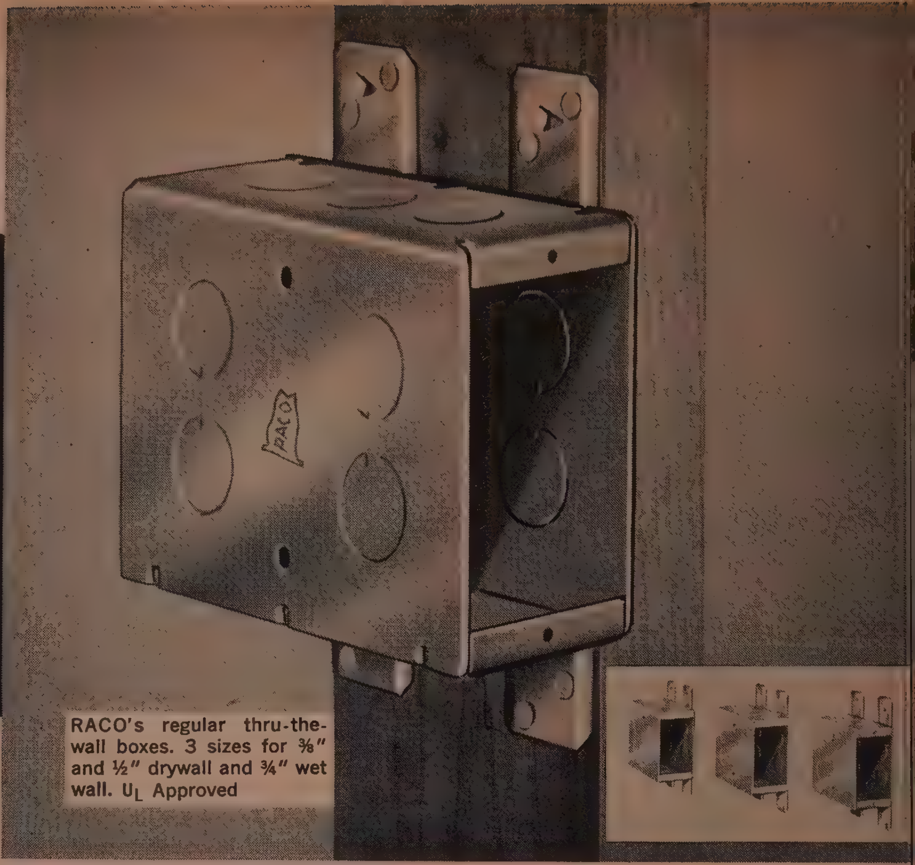
**ALLIS-CHALMERS**

*Pyro-Shield* is an Allis-Chalmers trademark.

A-1664

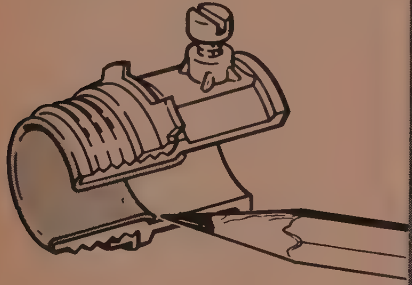
# NEW FROM RACO

**RACO E.M.T. Pressure Cast Set Screw Fittings with Staked Screws.** These rugged new fittings have staked screws that are flush with the inside. You never have to back off screws and the screws never fall out. Designed of top quality alloy. Concrete tight. Deep cut threads speed up installation. Connector and coupling available in five sizes ½″ to 2″.
$U_L$ Approved

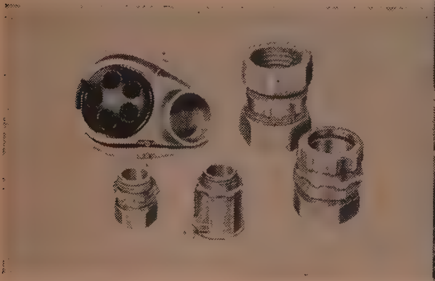


RACO's regular thru-the-wall boxes. 3 sizes for ⅜″ and ½″ drywall and ¾″ wet wall. $U_L$ Approved

# Cut Costs with

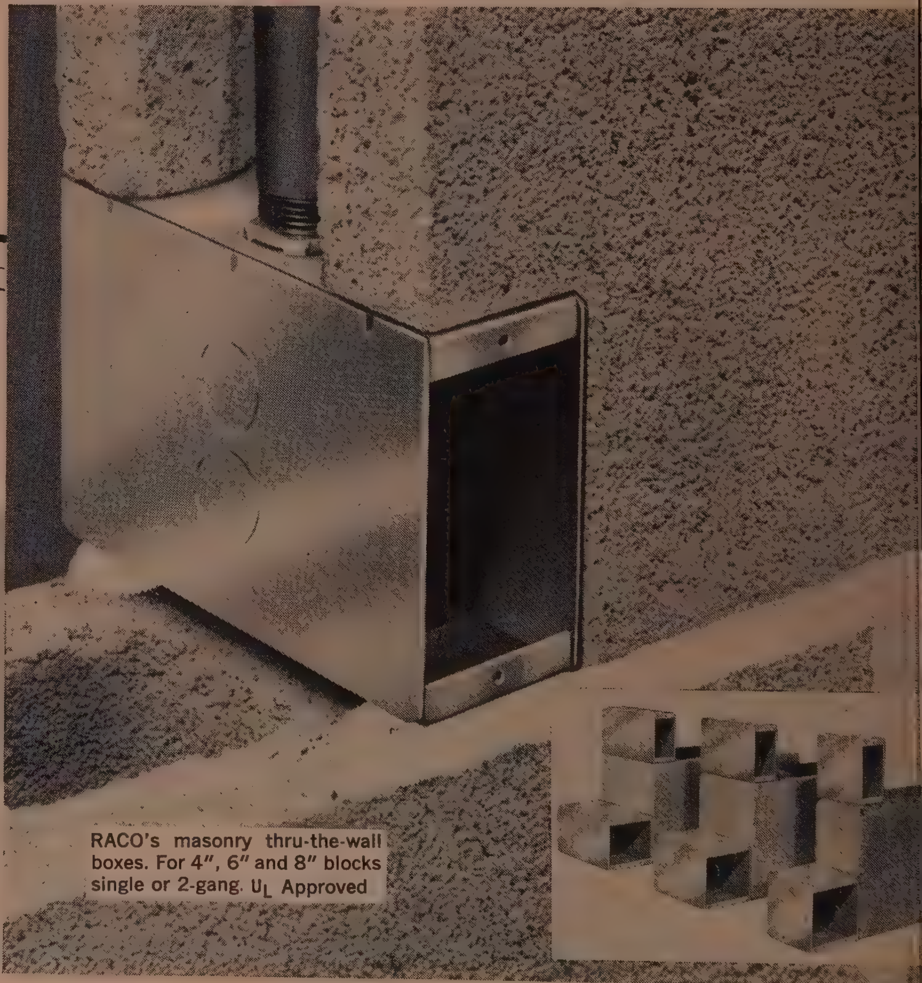


**E.M.T. Insulated Throat Set Screw Connector.** Cutaway above shows how RACO has rolled the insulated throat over the shoulder. This feature prevents throat from falling out, even with temperature changes. Eliminates the need for a separate plastic bushing. Available in six sizes ½″ to 2″.
$U_L$ Approved



**FITTINGS For Every Need**

- Rigid Conduit
- E.M.T. (Thinwall Conduit)
- Armored bushed cable, flexible metallic tubing and non-metallic cable
- Service entrances



RACO's masonry thru-the-wall boxes. For 4″, 6″ and 8″ blocks single or 2-gang. $U_L$ Approved

## REGULAR CONSTRUCTION **SAVE 50%**

Above: Remove KO's on both 4″ square boxes.

Below: Nothing to remove thus saving you installation time.

RACO WAY

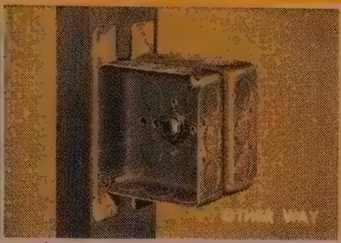
**OPERATION ELIMINATED**

Above: Nipple two 4″ boxes together, screw locknut on nipple and tighten.

Below: No nippling and no locknut required. RACO saves you material and time.

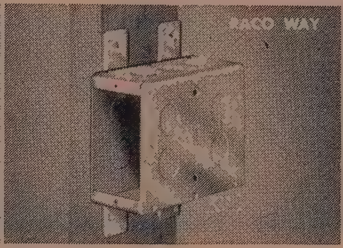
RACO WAY

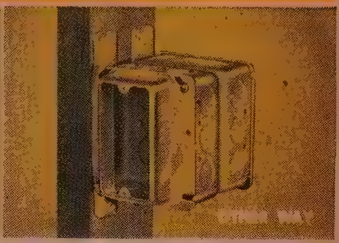
**OPERATION ELIMINATED**



Above: Nail two 4″ boxes to studding.

Below: One RACO thru-the-wall box, with mounting bracket can be nailed to the stud quickly and easily.





Above: Two 4″ square covers put in place.

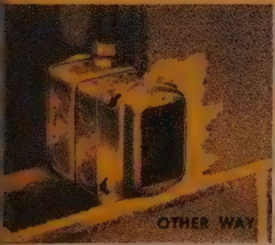
Below: No covers needed, thus . . . eliminating a costly operation.

RACO WAY

**OPERATION ELIMINATED**

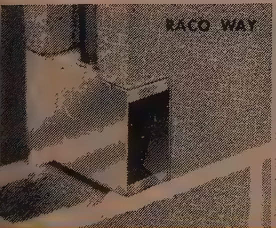
# RACO Thru-the-Wall Boxes

## MASONRY CONSTRUCTION **SAVE 38%**



Above: An oversized irregular area must be cut in the block for two 4″ boxes.

Below: Fitting square cornered RACO boxes require less work.



Above: Remove KO's from two 4″ boxes.

Below: Nothing to remove saving you time on-the-job.

RACO WAY

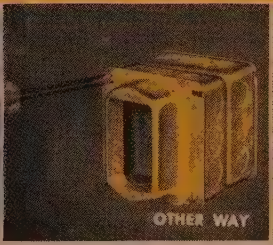
**OPERATION ELIMINATED**

Above: Nipple two 4″ boxes together, screw locknut on nipple and tighten.

Below: No nippling required eliminating costly labor and material.

RACO WAY

**OPERATION ELIMINATED**



Above: Two plaster covers installed on boxes.

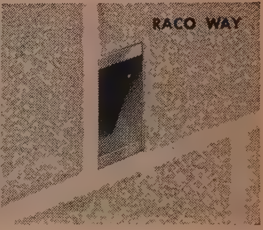
Below: No covers needed on RACO thru-the-wall boxes.

RACO WAY

**OPERATION ELIMINATED**

Above: Mudding around is a messy, time consuming job. Holes have to be retapped.

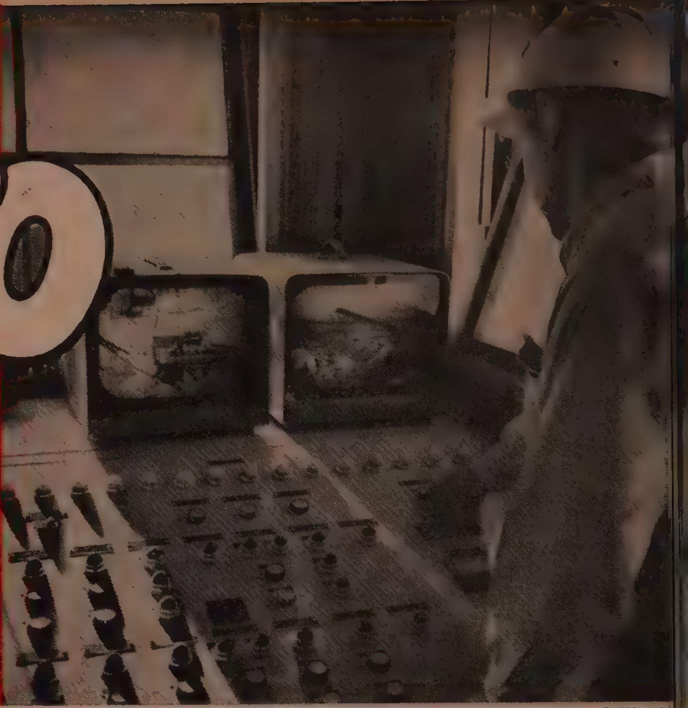
Below: RACO boxes give you a neater, faster job. Device holes are inside . . . no retapping.



RACO®

**ALL-STEEL EQUIPMENT INC. Aurora, Illinois**

# bridle your horsepower with BRONCO CONTROL CABLE



One man operates U. S. Borax & Chemical Corporation conveyor at Boron, Californi

## FOR THE **DEPENDABILITY** REQUIRED BY AUTOMATED INDUSTRY

**...a multi-conductor cable for every type of installation—mobile or stationary, in ducts, conduits, trays, troughs, direct burial, aerial suspension, high temperature...**

Virtually all of your control cable requirements can now be met by Bronco. Data given here indicates range of sizes shown in the new Bronco Control Cable Catalog, the sizes usually found in the very extensive stock carried in the Bronco network of Servicenters. The extraordinarily complete and versatile facilities for the manufacture of multi-conductor cables established by Bronco can handle your most unusual requests—mixed sizes, short and long lengths, combination power and control cables, shielded sub-assemblies...What's the maximum number of com ductors? Ask. Give us the a.w.g. size, we'll reply by return wire

## NEOPRENE

### TYPE SO PORTABLE UL approved

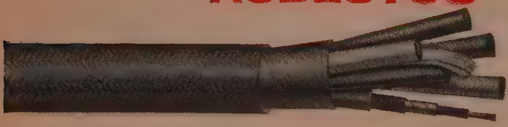
BRONCO Certified 66 NEOPRENE

Extra flexible, fine-stranded conductors insulated with color-coded SBR rubber with an outer protecting jacket certified to contain not less than 67.32% neoprene. Branded jackets with all identifying information molded in so it won't rub off. Sizes 18 through 10 with from 5 to 60 conductors, more on special order. Shielded type also available.

### STATION

Coated copper conductors either solid, coarse, or medium-fine stranded with a color-coded neoprene coating over each, a branded heavy neoprene outer protecting jacket. Sizes 14, 12, 10, 9, up to 37 conductors.

## ASBESTOS

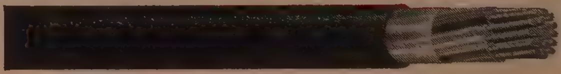


### TYPE AVA

For temperatures up to 110°C (230°F) Bronco makes AVA control cable with coarse- and fine-stranded conductors insulated with asbestos and varnished cambric, color-coded cotton braid, covered over all with a closely-woven, impregnated asbestos braid. Sizes 12 and 9. 1 to 19 conductors.

*NEW BRONCO CONTROL CABLE CATALOG is now off the press, write for your free copy.*

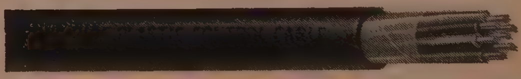
## PLASTIC



BRONC-hide stabilized with lead (Pb)

### GENERAL PURPOSE FLEXIBLE THERMOPLASTIC

PVC (polyvinyl chloride) insulation and PVC jacket, flexible-stranded copper conductors, brightly color-coded, 600 volts, sizes 18 through 10 with up to 40 conductors.



### I.M.S.A.

Bronc-hide 600 volt Municipal Signal Control Cable has solid copper conductors, is made in four types: with either polyethylene or PVC insulation, with a PVC jacket of either normal thickness, or extra-heavy for direct burial. Sizes 14 and 12 with 3 to 12 conductors.

### PNB

Bronc-hide PNB is a small diameter cable for operating temperatures from —40°F to +167°F. Flexible-stranded, coated copper conductors have polyethylene insulation covered with nylon, a PVC jacke over all. Stock sizes are 14, 12, and 9 with from 1 to 19 conductors.

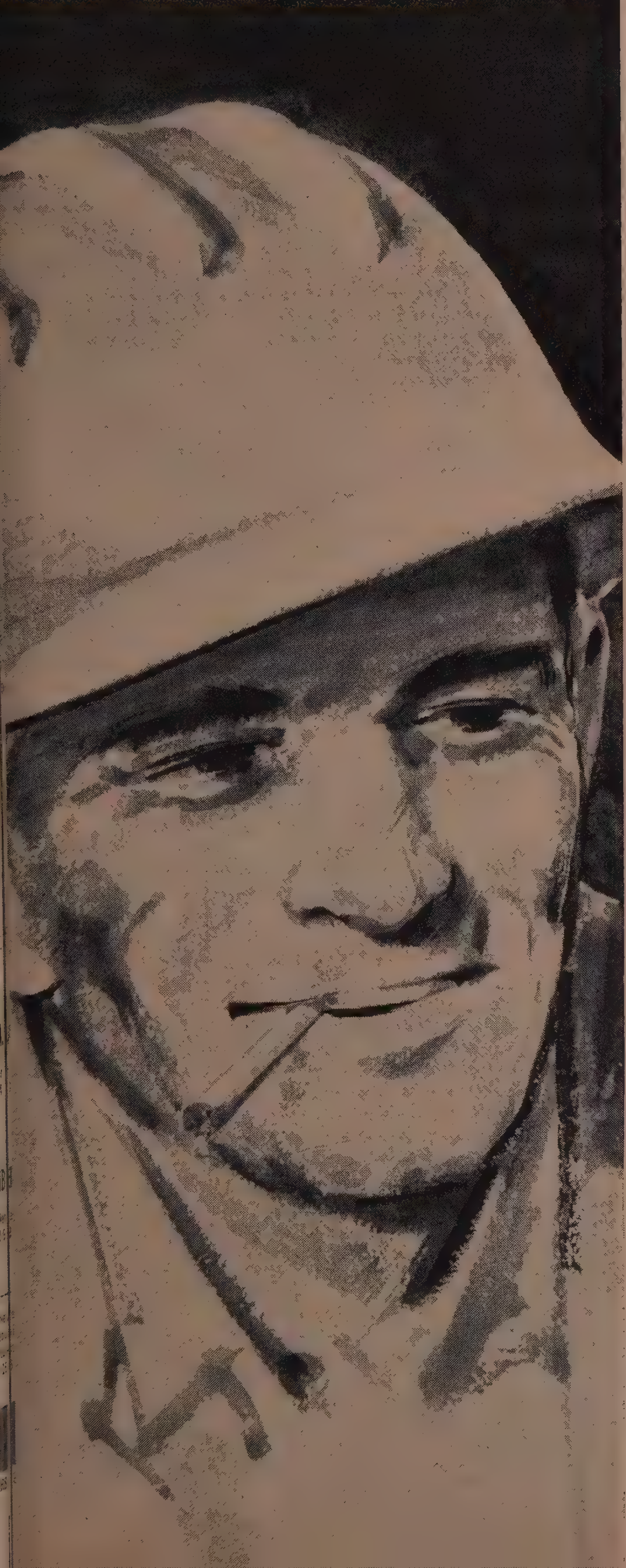
BRONC-hide Thermoplastic Station Control Cables with 19-strand flexible conductors are made in a complete range of sizes in two types—1000 volt with polyethylene insulation and PVC jacket; 600 volt with PVC insulation and PVC jacket. Bronc-hide 300 volt telemetering cable with paired, solid, bare copper conductors are made in sizes 22, 19, and 16 with up to 50 pairs.

25th ANNIVERSARY 1962

**WESTERN INSULATED WIRE COMPANY / LOS ANGELES 58, CALIFORNIA**

*A QUARTER CENTURY OF SERVICE TO INDUSTRY SELLING NATIONALLY THROUGH ELECTRICAL WHOLESALE DISTRIBUTORS*

"Hard Hats" Prefer
T&B Distributors . . .

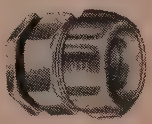


because they're a local source for over 60,000 Code approved products. T&B products cut installation costs. T&B distributors reduce your operating costs.

Here is an example of a product line that can put dollars into your pocket. All of the products below are listed by Underwriters' Laboratories, Inc., and meet or surpass the requirements of T&B Laboratories and the National Electrical Code, paragraph 373-6 (b). The bright blue nylon liner is a T&B exclusive . . . insulates and protects wire **during** and **after** installation. A flawlessly smooth surface measurably reduces wire pulling effort. The insulated throat is unaffected by moisture, high operating temperatures and common corrosive atmospheres. The result is lowest installed cost and no callbacks.

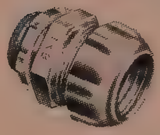
INSULATED THROAT FITTINGS FOR LIQUID TIGHT FLEXIBLE CONDUIT

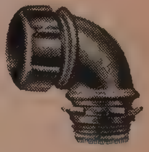
1.

2.


1. Liquid Tight for Threaded Outlets
2. Chase® Liquid Tight for JIC Boxes

INSULATED THROAT FITTINGS FOR STANDARD RIGID CONDUIT

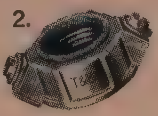
1.

2.

3.


1. Threadless Connectors
2. Chase® Nipples
3. Insulated Threadless Elbow

BLUE BUSHINGS FOR RIGID CONDUIT

1.

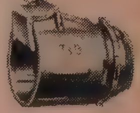
2.

3.

1. Unbreakable Plastic Bushing
2. Insulated Grounding Bushing
3. Insulated Metallic Bushing

INSULATED THROAT FITTINGS FOR E.M.T. AND FLEXIBLE CONDUIT

1.

2.

3.


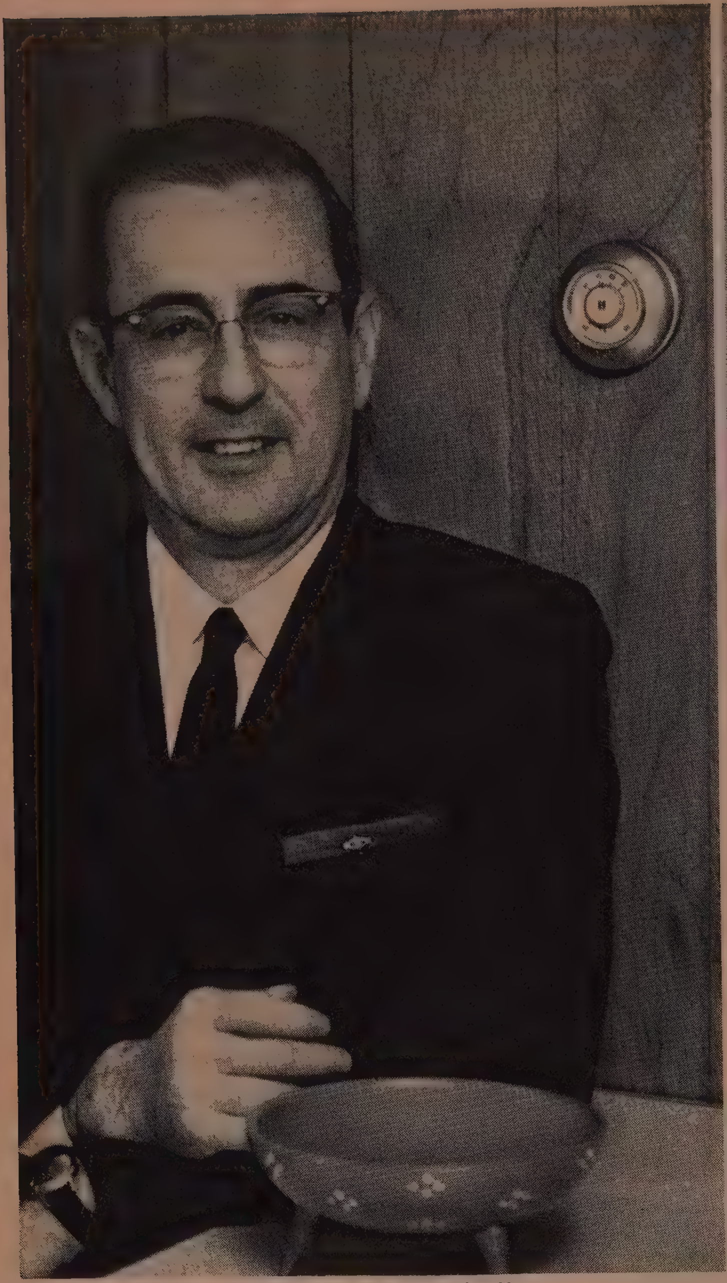
1. E.M.T. Raintight Connector
2. E.M.T. Raintight Short Elbow
3. Straight Tite-Bite® for "Flex"

SOLD COAST-TO-COAST THROUGH AUTHORIZED T&B DISTRIBUTORS

T&B ENGINEERED THOMAS & BETTS

The Thomas & Betts Co., Incorporated • Elizabeth, New Jersey
In Canada, Thomas & Betts Ltd. • Montreal

Insulated throat fittings are Patented.



"Extremely accurate,"
Denver sales manager

"Beautiful styling,"
Seattle accountant

# 3 out of 4 people prefer

## Put this over-all preference to work for you with Honeywell electric hea

In a recent survey of homeowners, three out of four, familiar with controls, preferred Honeywell.

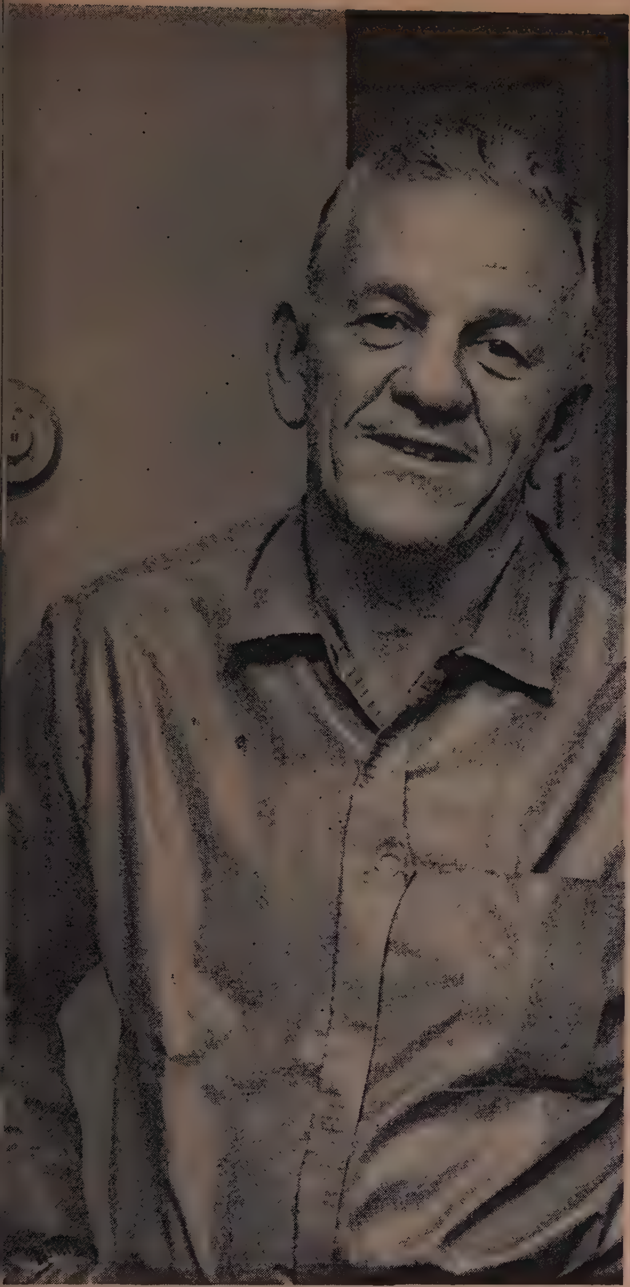
Most of your new customers have lived with Honeywell controls. Shouldn't you put this overwhelming preference to work for you in your installations?

When you combine Honeywell with your own fine brands of electric heating equipment, you've got a combination that can mean more customer satisfaction, easier sales, more profits. Let Honeywell's new electric heat thermostats and new linear limit control join your sales team. They can be a big help.

**Low-Voltage Controls let you offer variety**

With the Honeywell R8097 Relay, which allows you use Honeywell's low-voltage controls, you can off the widest range of low-voltage thermostat combin tions in the industry. All the way from the mo economical to the famous Honeywell Round to t deluxe thermostats and Control Centers.

Why don't you ask for detailed information both low-voltage and line-voltage temperature co trols now? Just call the nearest Honeywell sales office write Honeywell, Dept. EC8-24, Minneapolis 8, Minn



"Mighty reliable,"
Detroit truck driver

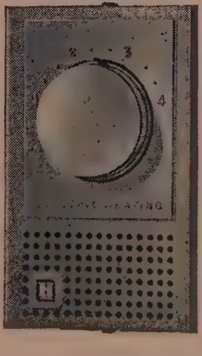
"I'll make my own controls,"
Free-lance scientist

# Honeywell Controls

## controls, too. They'll help you sell the high quality of your installation.

**The new wall-mounted Honeywell T462 Line Voltage Electric Heat Thermostat** (and unit mounted T460) give dependable, worry-free performance. The control range is from 40° to 85° with a one-half degree differential.

New, rugged construction makes the units stronger. They are easier to set, rugged and dependable, too. They operate electric heaters up to 5000 watts, responding to both radiant and convected heat. Two switching variations are available in both models. Model T462A and T460C are SPST that make on a temperature fall and provide a line break at NO HEAT. Models T462B and T460D have the added feature of breaking both lines in OFF position.



**NEW, EXCLUSIVE ELECTRIC HEAT TRAINING PROGRAM!** Sales and service meetings studying a new and thorough working manual: "Fundamentals of Automatic Electric Heating." Call the Honeywell office nearest you about the next session.

**Honeywell**

*First in Control*

# S&C power fuses are going places

The power fuse has come a long way in fifty years—from S&C's liquid fuse to S&C's sophisticated, boric acid fuse of today. Now, with interrupting ratings up to 1,000,000 kva in the Type SM (720 amperes continuous), and 2,000,000 kva in the Type SMD (540 amperes continuous), &C power fuses are being adapted to virtually every conceivable system rotection need. Power fuses are used indoor and outdoor; enclosed and n the open; in plants and buildings; on transmission and distribution ines; on overhead poles; in pad mounted gear; and in underground aults. These fuses provide predictable protection with simplicity and conomy. That's why they are going places.

## laces like these:

### ON WALLS

Now you can hang 500,000 kva on a wall with S&C's line of high-voltage metalclad fuses. These compact units conserve valuable floor space while providing fully adequate high-voltage fault protection on industrial and commercial power circuits.

### IN VAULTS

Newest addition to S&C's metalclad fuse line is the submersible style for use in vaults or basements where flooding is a possibility. Rated at 4.8 and 14.4 kv, these units carry 200E or 400E amperes continuous, and have interrup ratings up to 500,000 kva.

### 3. IN PLANTS AND BUILDINGS

Power fuses, combined with load interrupters and p aged as S&C Metalclad Switchgear, cut protection cost half by replacing circuit breakers. Power fuses pro needed protection against permanent destructive faults countered on industrial and commercial high-voltage cuits. (Load interrupters do the switching.)

### 4. IN SUBSTATIONS

The 1,000,000 kva interrupting rating (at 34.5 kv S&C's Type SM Power Fuse has made it first choice for tection of large power transformers in distribution sub tions. This means low-cost, maintenance-free protec against primary and secondary faults, without main outages.

### 5. ON POLES

S&C power fuses can be pole-mounted for line sectio izing, fusing distribution transformers where short-cir currents are unusually high, and protecting distribu feeders. Low energy arc-extinguishing action reduces haust blast hazards to tolerable limits for linemen and public alike.

### 6. IN PAD MOUNTED GEAR

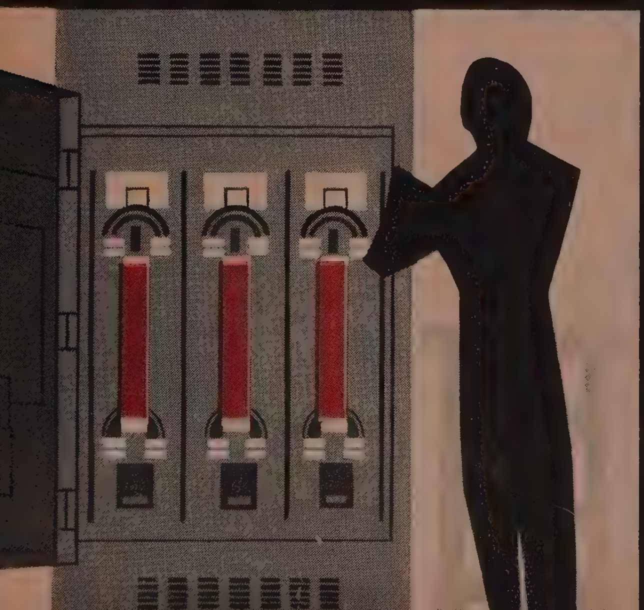
At sectionalizing points or connected to pad moun transformers, S&C power fuses protect (and even swit residential underground circuits—in air. The wide choic fuse ratings enables the utility to uprate its undergro system to accommodate future growth needs.

OUR
GOLDEN
JUBILEE

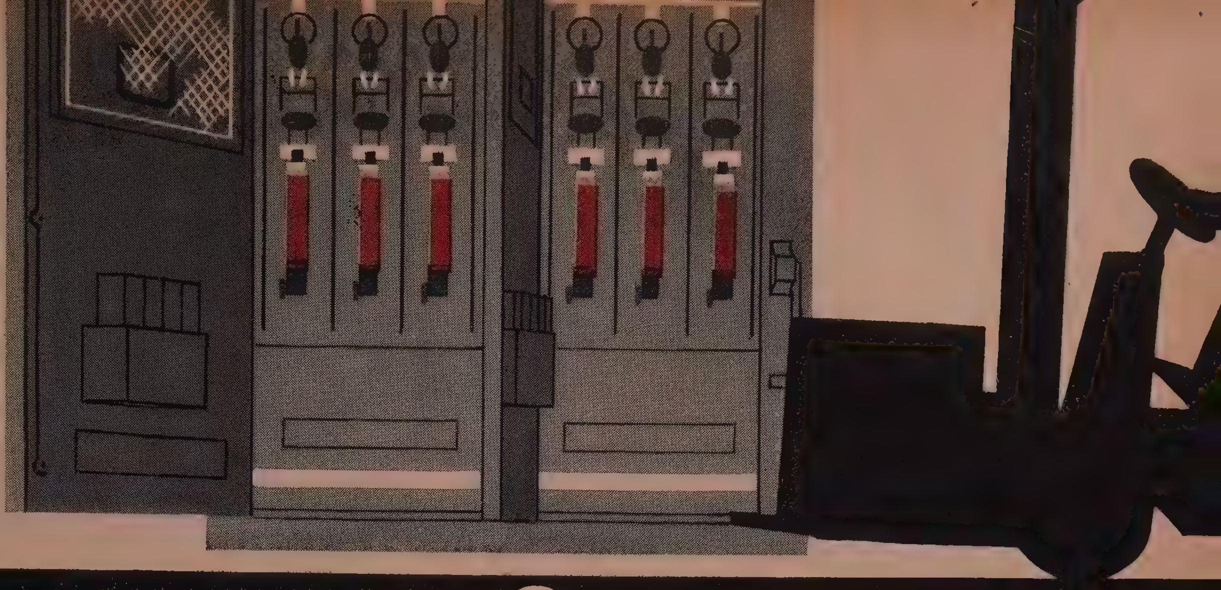
For additional information on S&C power fuses, contact your local S&C representative or write to:

**S&C ELECTRIC COMPANY**
6605 Ridge Boulevard • Chicago 26, Illinois
Specialists in High Voltage Circuit Interruption since 1911

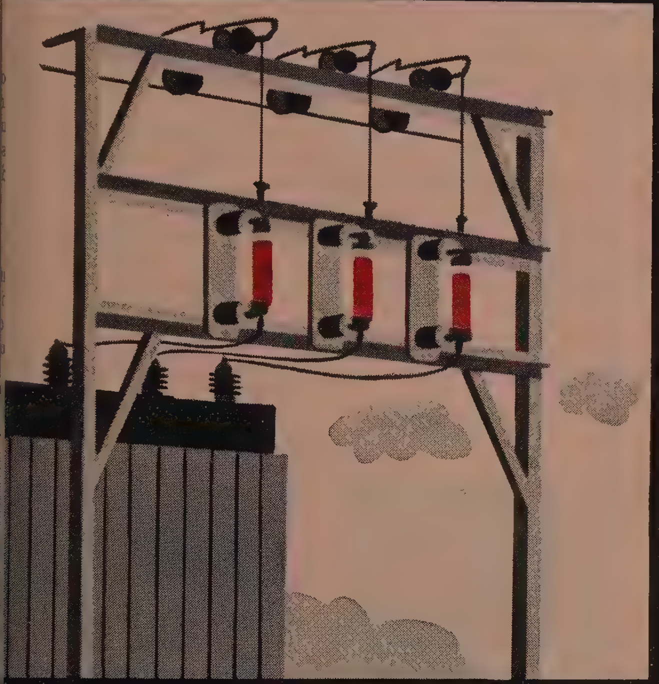
1



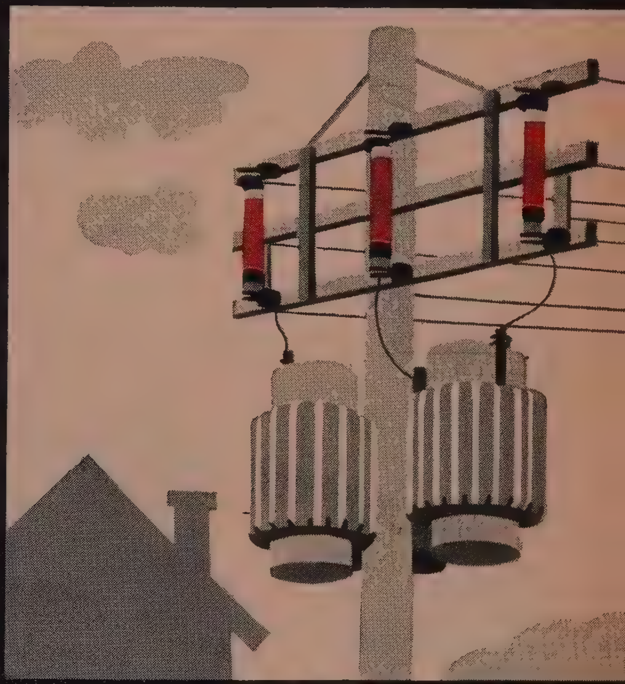
2



3

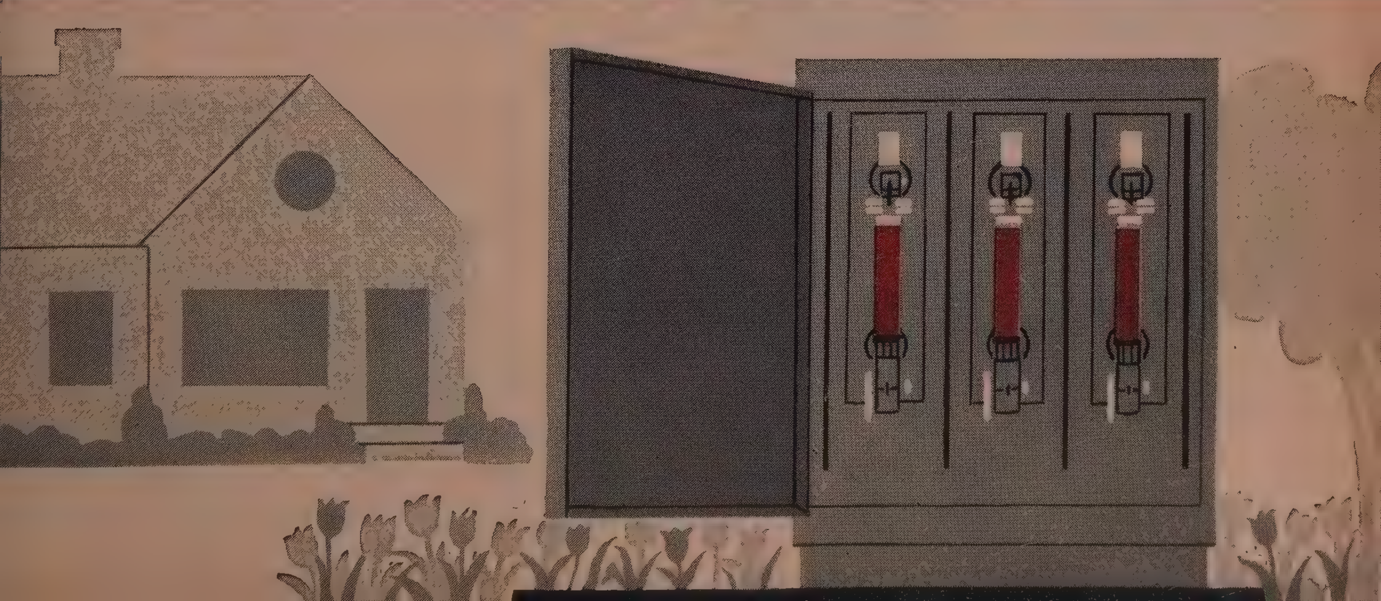


4



5

6

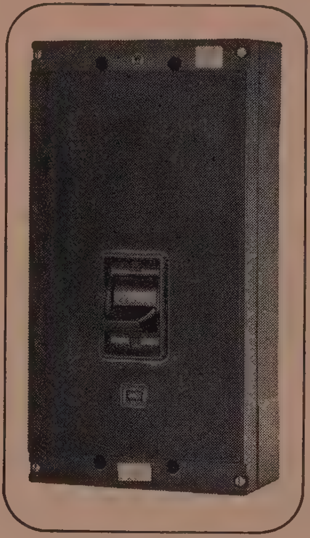


# A buyers' guide to optimum circuit protection

### 100,000 amperes interrupting capacity

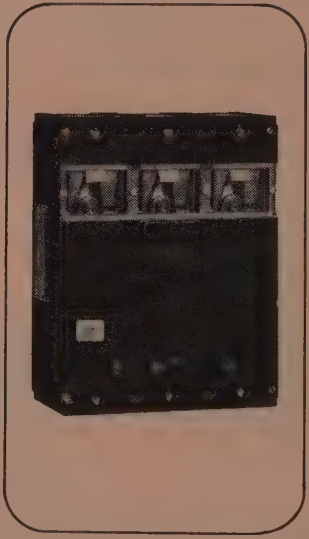
TRI-PAC—The Westinghouse Tri-Pac® circuit breaker offers triple circuit protection in one compact unit: an inverse time delay thermal trip, an instantaneous magnetic trip, and current limiting protection. Continuous current rating to 600 amps, two or three poles; interrupting capacity up to 100,000 amps.

### High fault protection at low cost



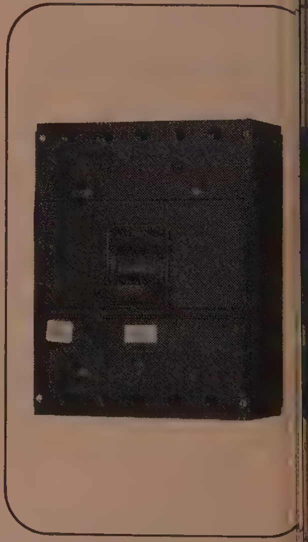
MARK-75—With high interrupting rating, this economical Mark 75 breaker provides complete protection in systems, like networks, where available fault currents may reach 75,000 amperes at 240 volts a-c; 30,000 amperes at 600 volts a-c. Available in current ratings from 70 to 1,000 amps, two or three poles.

### Visible contacts for special safety codes



SAF-T-VUE—Saf-T-Vue® breakers permit the operator to see whether the contacts are open or closed. This feature is ideal where safety codes require visible contacts for maintenance men and operators. The transparent window is heat-resistant thermo-plastic that won't scorch or cloud with normal overloads. Available in ratings up to 1,000 amps a-c.

### Complete protection for most applications

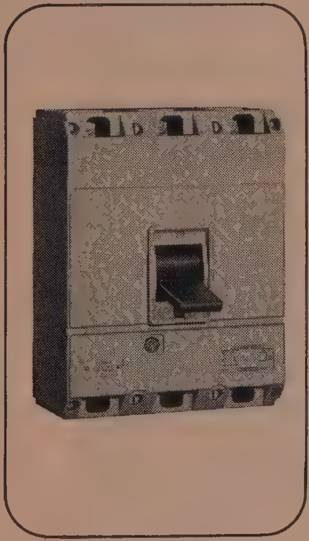


THERMAL-MAGNETIC—Wes inghouse Thermal-Magneti breakers have become th standard for protection of distribution system 600 volts o less. Available in all fram sizes, this breaker provide instantaneous opening o short circuits. On sustaine overloads, the higher the cu rent, the shorter the openin time. Factory tested for un matched reliability; availabl in ratings to 1,000 ampere e molded case circuit breaker served need, that's all Westinghouse would . But precise protection at lowest cost for specialized solutions. That's why inghouse builds hundreds of variations e seven basic types featured here. It's vorld's most complete line, based on 35 years of continuing product research development. Use this buyers' guide for ral applications. For specific circuit ction problems, contact your Westing- e representative, Westinghouse distrib- , nearest independent panelboard/ hboard builder, or write Westinghouse tric Corporation, Standard Control ion, Beaver, Pennsylvania. *You can be . . if it's Westinghouse.*

## Fast, hort-circuit protection only

NETIC-ONLY—Designed fically for short circuit iction, the magnetic-only t breaker is used on sys- where overload protec- is provided by other ns. Front adjustment s five main setting posi- and four mid-setting ions. Typical applications notors, resistance weld- and resistance heating. able to 1,000 amperes, nuous current ratings.

## Rugged construction for military use



NAVY-TYPE—The Navy-type breaker has very high mechanical strength, and resistance to fire, moisture and shock. Under shock conditions the trip stays in latch position, but doesn't prevent thermal or magnetic trips from overload or short-circuit. Has plug-in connector, interchangeable trip units and calibration for 50°C. Available in ratings to 600 amps at 500 volts a-c.

## Precise calibration for low currents

TYPE-550—The Type-550 is designed specifically for sensitive electronic equipment where fractional ampere ratings and exacting protection are required. Special plating resists moisture and fungus. Interrupting capacities range from 1,000 to 3,000 amps with ratings from .02 to 50 amps, maximum voltages of 250 a-c and 50 d-c.

J-30344

**Westinghouse**

# Now from Simplex .

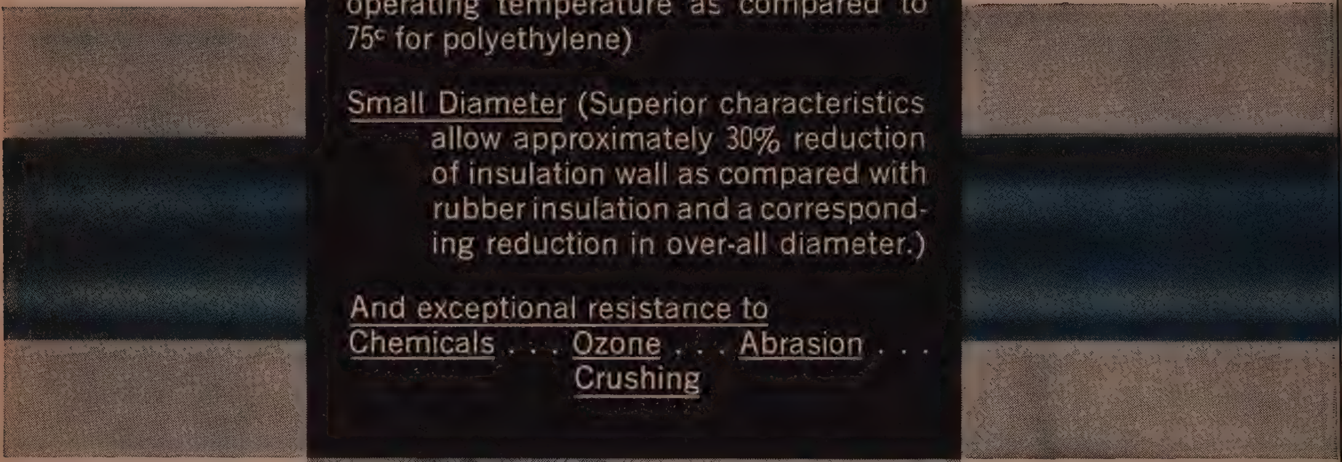
# CROSS-LINKED

A new insulated power cable that offers you exceptional properties at lower-than-rubber cost, including:

Higher Ampacity (90°C maximum conductor operating temperature as compared to 75°C for polyethylene)

Small Diameter (Superior characteristics allow approximately 30% reduction of insulation wall as compared with rubber insulation and a corresponding reduction in over-all diameter.)

And exceptional resistance to
Chemicals . . . Ozone . . . Abrasion . . .
Crushing



Simplex 15KV C-L-P being installed at West Nyack, N.Y. by Orange and Rockland Utilities, Inc. C-L-P's smaller diameter means lighter weight, easier handling.

# C-L-P T.M.

# POLYETHYLENE with VOLTAGES TO 15 KV

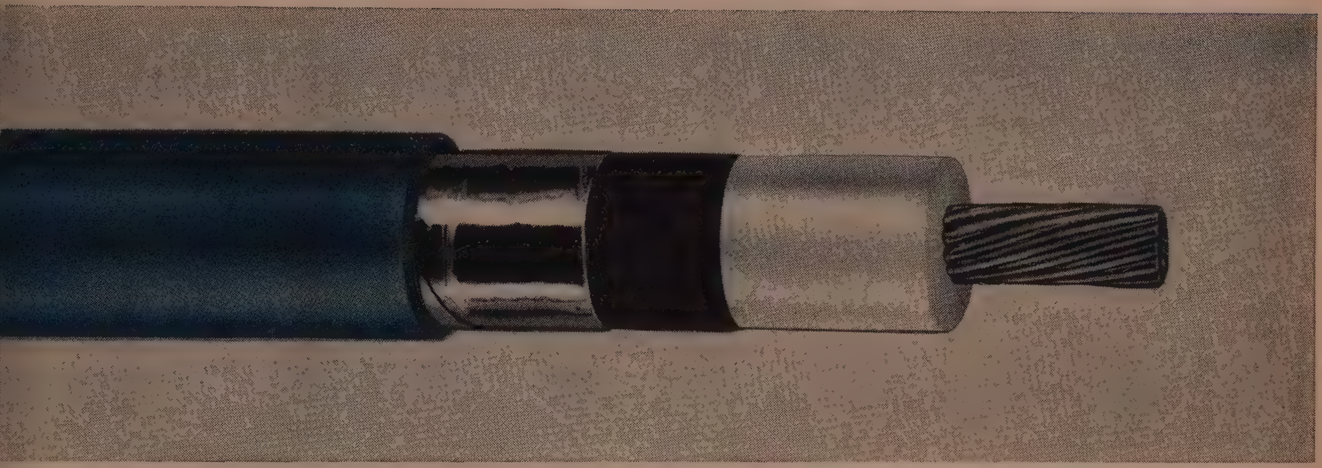


ILLUSTRATION ACTUAL SIZE

Simplex C-L-P Power Cables feature a newly developed *thermosetting* polyethylene insulation with a cross-linked molecular structure. The cross-linking of the molecules results in an unusually stable polyethylene which — with further Simplex refinement — combines some of the best properties of rubber and polyethylene in one insulation. C-L-P insulated cables are suitable for use in ducts, conduit or trays and for aerial, submarine or direct burial applications under almost any conditions of environment, yet their cost is less than comparable rubber-insulated cables.

Now installed and operating, C-L-P cross-linked polyethylene cables represent one of the most important cable breakthroughs of the past 25 years. Write Simplex today for performance and cost comparison data.

**Simplex**

**WIRE & CABLE CO.**

EXECUTIVE OFFICES: Cambridge, Mass.

Plants at Cambridge, Mass., Portsmouth, N. H., Westbury, L. I., Monrovia, Calif.

**MEET A TOUGH NUT . . .** Just a gimmic to catch your eye? Hardly, it's symbolic because hickory nuts are tough. So are new "Sisal" impregnated NON METALLIC new work boxes by UNION. Now twice as strong, and don't forget the advantages you already know about such as lower initial cost—less installation time—no box grounding—no clamps—exclusive plaster seal—handy knock-outs. So if you've been drooling over the savings Union offers but have hesitated in favor of the old fashioned way—forget it! You deserve as much profit as your competitor. Complete line—boxes and covers, "Weatherbest" lighting fixtures, pigtail and pin type sockets, insulating, grounding and male bushings. UL approved. Contact your distributor now.

**UNION INSULATING CO.**
PARKERSBURG, WEST VIRGINIA

## LOOK FOR THE PURPLE LINING THAT MAKES CABLE PULLS 61% EASIER

In tests† comparing lined and unlined conduits (including steel) the purple silicone lining in Kaiser KINGFISHER let cables slip past the third bend up to 36% easier . . . past the fourth bend up to 61% easier.

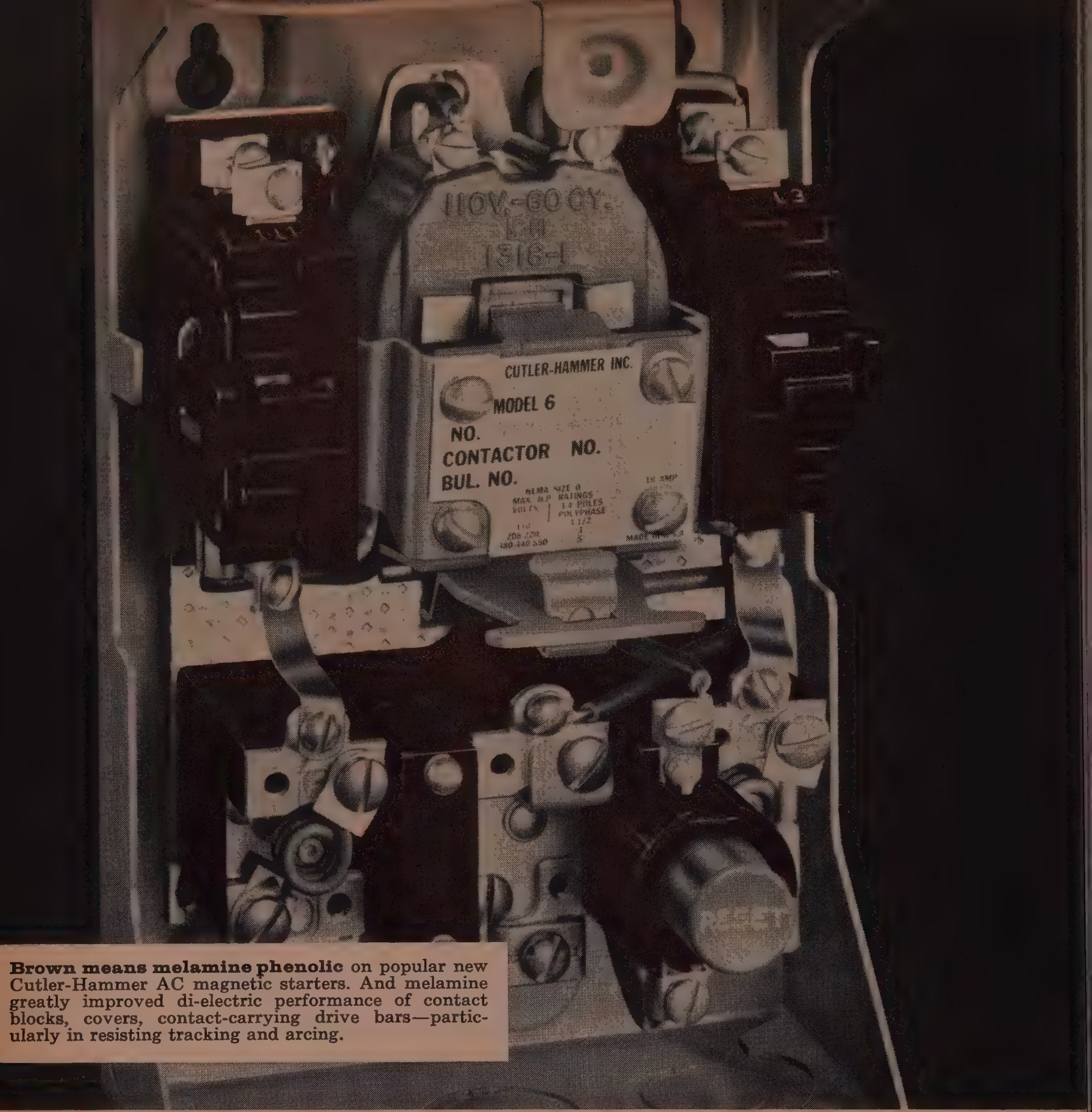
Kaiser KINGFISHER gives you four more time saving differences: light weight, easy cutting, uniform bending, and exclusive high strength forged couplings.

Only competitively priced Kaiser KINGFISHER has all the advantages of aluminum plus slick K-40 silicone lining. Cut installation costs on your jobs: look for the purple lining that makes cable pulls easier . . . from your authorized Kaiser KINGFISHER Distributor.

---

†Using 3 #2RHW cables in 1¼″ conduit.
*Trademark of Kaiser Aluminum & Chemical Corporation.

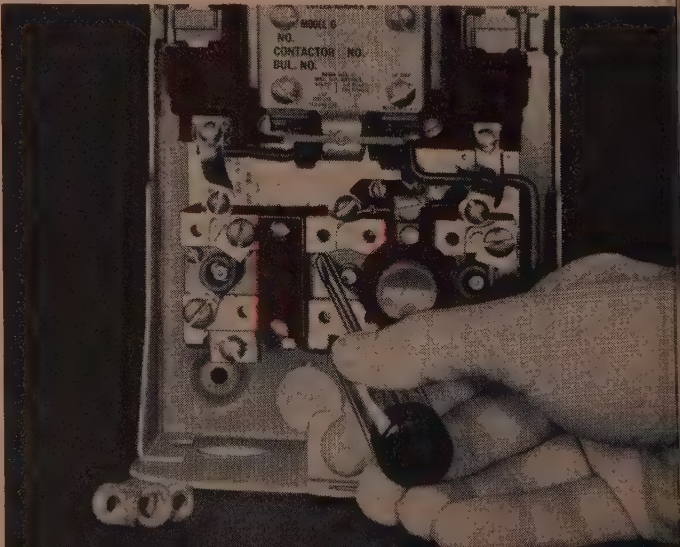
KAISER ALUMINUM



**Brown means melamine phenolic** on popular new Cutler-Hammer AC magnetic starters. And melamine greatly improved di-electric performance of contact blocks, covers, contact-carrying drive bars—particularly in resisting tracking and arcing.

**Cover control conversion** is easy with new kit on all sizes 00 through 5. Provides choice of reset only, start-stop or three-position selector from kits stocked by Cutler-Hammer distributors.

**Get 3rd coil protection** on any Cutler-Hammer starter by adding a spindle and coil to standard block on all new starters. No additional control or power circuit wiring—no extra overload relay to add.



CONTROL

*New melamine moldings, new 3rd coil protection, new operator conversion kit*

# These 3 improvements make Cutler-Hammer starters even more dependable, more economical to stock

**Greater convenience, greater performance** are yours in the improved Cutler-Hammer AC magnetic motor starters. Convenient, because any new Cutler-Hammer starter can be easily adapted in the field to provide 3-coil overload protection where required, as well as the cover control arrangement you want.

**BETTER ELECTRICAL PERFORMANCE**

New melamine-phenolic molding add an advance in the science of plastics to Cutler-Hammer Motor starters' electrical performance. Because melamine is many times as resistant to moisture, problems of arcing and tracking are virtually eliminated in the key moldings it replaces.

**FIELD CONVERSION KITS**

While starters are available from stock with any of the 3 types of cover controls, easy-to-stock kits now make it possible to change any Cutler-Hammer starter from reset-only cover control to start-stop or three-position selector switch.

The same principle now applies to overload protection. Addition of an inexpensive spindle and a coil will provide 3-coil protection for any Cutler-Hammer starter destined for isolated or unattended operation.

All this is in addition to top reliability, quick availability, long contact life and easy maintenance that have made Cutler-Hammer starters the smart buy for years and years.

For complete information on the starter line designed to industrial standards, proven in thousands of applications and exceeding NEMA requirements in every respect send for publication LO-70-Q241. Then see your Cutler-Hammer Distributor for quick service on the next starter you need.

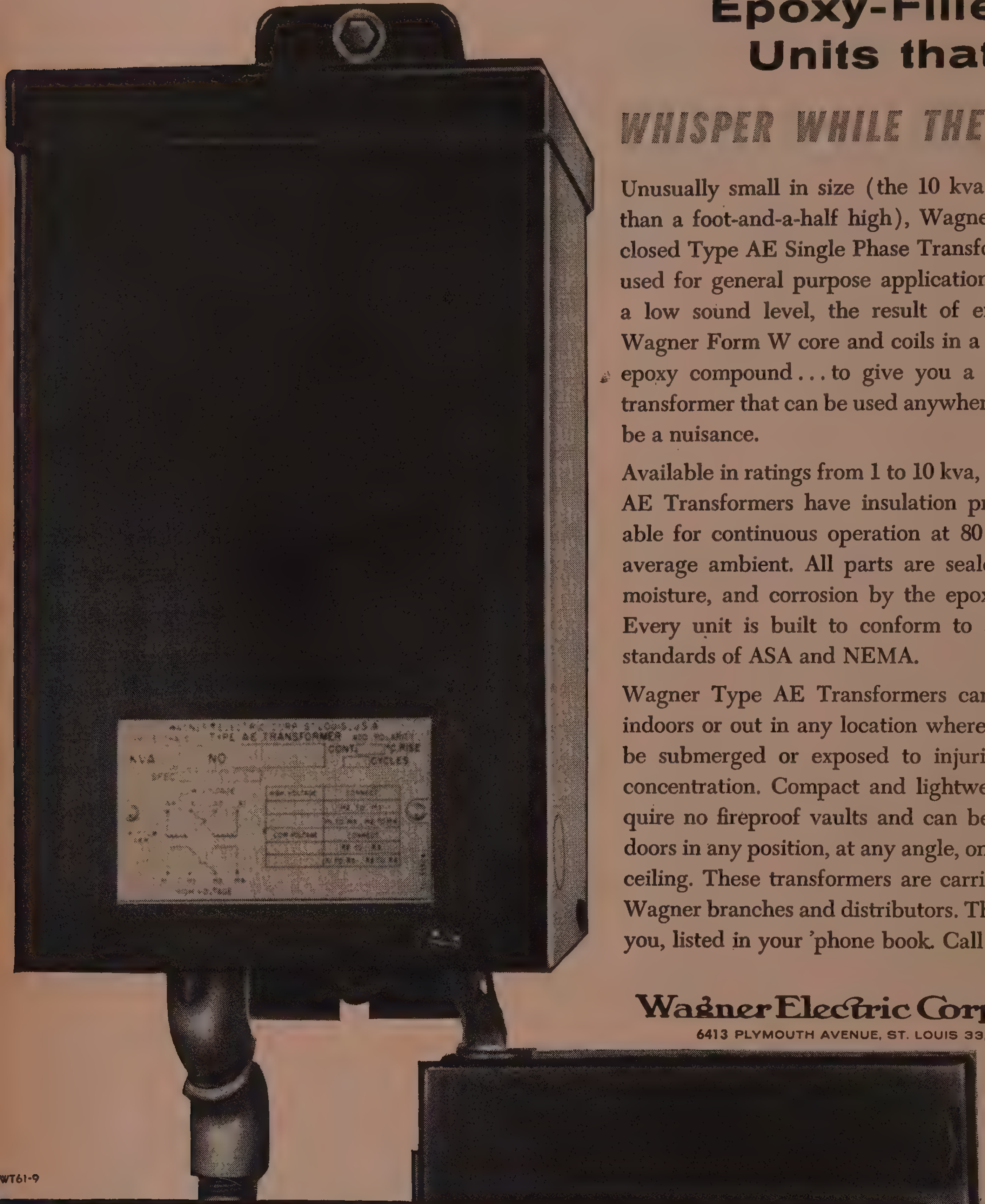
*WHAT'S NEW? ASK...*

**CUTLER-HAMMER**

Cutler-Hammer Inc., Milwaukee, Wisconsin • Divisions: AIL; Mullenbach • Subsidiaries: Uni-Bus, Inc.; Cutler-Hammer International, C.A. • Associates: Cutler-Hammer Canada, Ltd.; Cutler-Hammer Mexicana, S.A.

CONTROL

# WAGNER® DRY-TYPE GENERAL PURPOSE TRANSFORMERS



## Compact Epoxy-Filled Units that

## WHISPER WHILE THEY WORK

Unusually small in size (the 10 kva rating is less than a foot-and-a-half high), Wagner® totally-enclosed Type AE Single Phase Transformers can be used for general purpose applications. They have a low sound level, the result of encasing small Wagner Form W core and coils in a solid block of epoxy compound . . . to give you a whisper-quiet transformer that can be used anywhere noise would be a nuisance.

Available in ratings from 1 to 10 kva, Wagner Type AE Transformers have insulation protection suitable for continuous operation at 80°C in a 30°C average ambient. All parts are sealed from dust, moisture, and corrosion by the epoxy compound. Every unit is built to conform to all applicable standards of ASA and NEMA.

Wagner Type AE Transformers can be installed indoors or out in any location where they will not be submerged or exposed to injurious fumes in concentration. Compact and lightweight, they require no fireproof vaults and can be mounted indoors in any position, at any angle, on wall, floor, or ceiling. These transformers are carried in stock at Wagner branches and distributors. There's one near you, listed in your 'phone book. Call or write now.

**Wagner Electric Corporation**
6413 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.

WT61-9

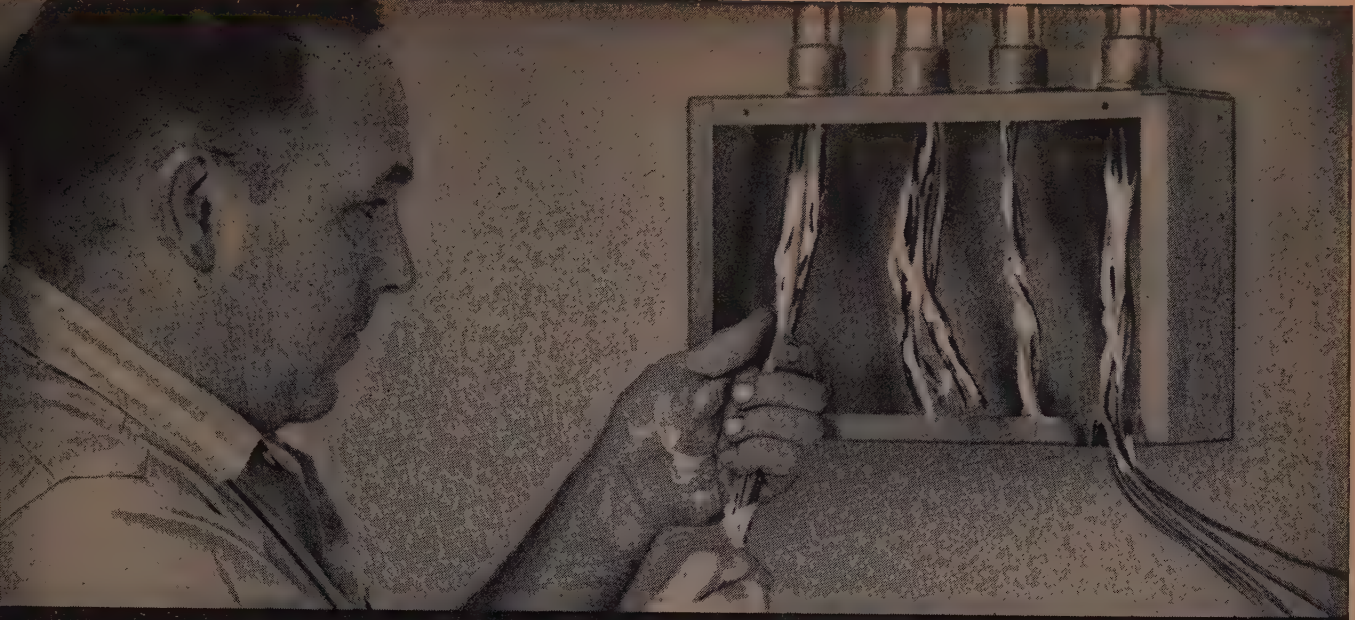
### SPECIFICATIONS

Type AE—Single Phase—1 to 10 Kva 80° C Rise, 60 Cycles.

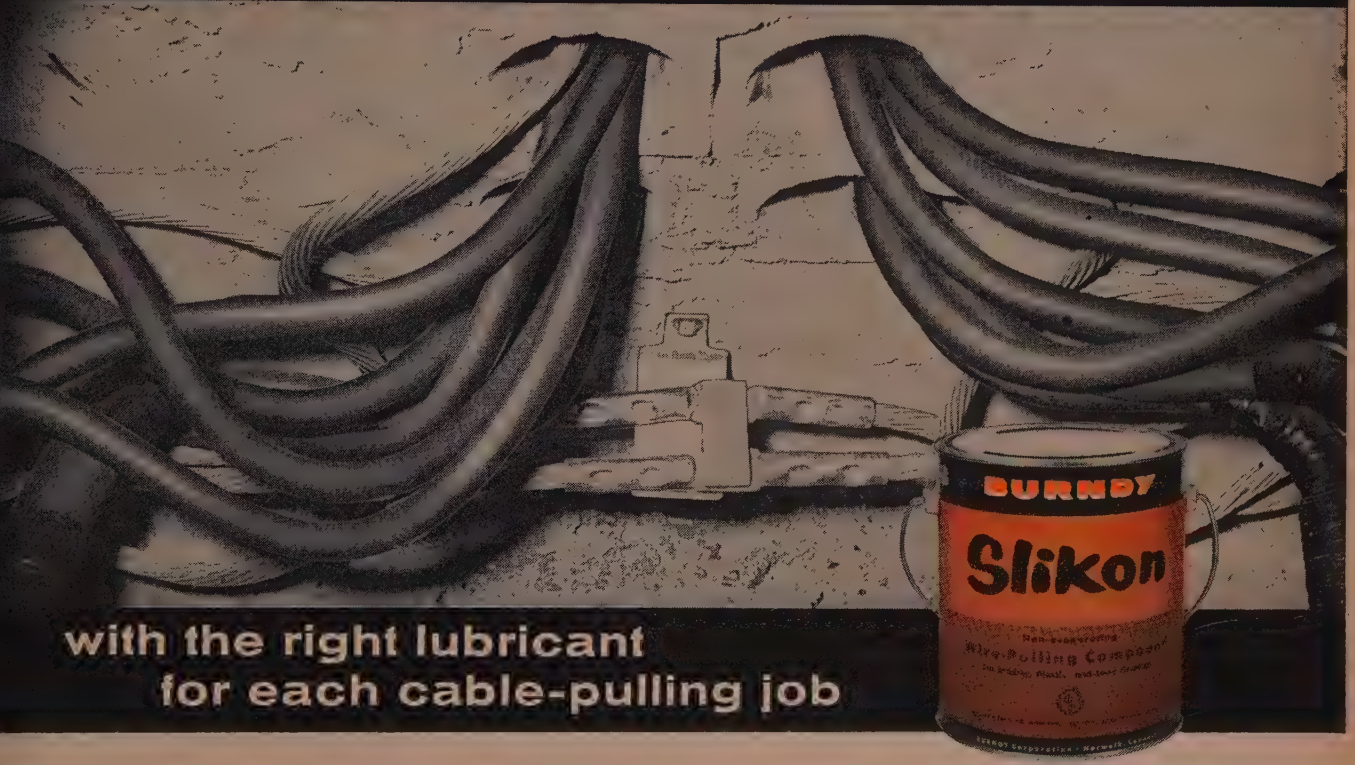
High Voltages: 120 x 240; 240 x 480; 600 volts, no taps; 480, 600 volts, 2—5% taps below normal.

Low Voltage: 120/240 volts.

| KVA | DIMENSIONS IN INCHES | | | NET WEIGHT POUNDS | AVERAGE SOUND LEVEL DECIBELS |
|---|---|---|---|---|---|
| | Height | Width | Depth | | |
| 1 | 10 13/16 | 6 5/16 | 6 3/16 | 28 | 37 |
| 1½ | 11 13/16 | 6 5/16 | 6 3/16 | 34 | 38 |
| 2 | 13⅛ | 6 13/16 | 7 3/16 | 46 | 38 |
| 3 | 14⅛ | 6 13/16 | 7 3/16 | 62 | 39 |
| 5 | 15 9/16 | 9¾ | 9¼ | 93 | 39 |
| 7½ | 16 1/16 | 9 11/16 | 10 7/16 | 130 | 39 |
| 10 | 17⅛ | 11⅛ | 10¼ | 167 | 39 |



# EASY DOES IT...



## with the right lubricant for each cable-pulling job

Save time and money installing cable in conduit . . . protect cable from damage . . . assure service continuity . . . with a cable lubricant engineered for your job's requirements.

Because conditions vary from job to job—diameter and length of cable, kind of insulation, number of bends, friction in the duct—Burndy provides these **four** tested cable lubricants, for a variety of service conditions. One of the four is the Burndy ubricant for your job . . . ask Burndy to help you select the cable-pulling lubricant you need.

**Burndy SLIKON,** for cable covered with rubber, many kinds of plastic, or lead, for installation in steel or aluminum conduit.

**Burndy ALBENTONITE CABLE LUBRICANT,** for cables with polyethylene and similar insulations.

**Burndy IMPROVED CABLE PULLING COMPOUND,** specifically for lead-covered cable for installation in ducts of all types.

**Burndy PROTECTANT 626,** for lead covered cable for installation in ducts and manholes subject to flooding and other severe conditions.

**BURNDY**

81-19

NORWALK, CONNECT. BICC-BURNDY Ltd. Prescot, Lancs., England In Europe: Malines, Belgium TORONTO, CANADA

WHEN YOU CONSIDER FLUORESCENT LAMP BALLAST

# PROTECTION

*remember...*

AUTOMATIC RE-SETTING

**ADVAN guard®**

THERMAL PROTECTION

*saves you money!*

## HERE'S THE PROOF!

| TYPE BALLAST PROTECTION | CONDITION OF BALLAST AFTER OPERATION DUE TO: | | | | BALLAST COST WITHOUT PROTECTION* | COST OF BALLAST PROTECTION* | BALLAST COST WITH PROTECTION* | COST OF REPLACEMENT BALLAST* | REPLACEMENT LABOR COST | TOTAL COST DUE TO PREMATURE DESTRUCTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | TEMP. IN EXCESS OF U/L-CBM SPECIFICATIONS | HIGHER THAN NOMINAL LINE VOLTAGE | LAMP RECTIFICATION | LAMP FAILURE | | | | | | |
| ADVAN-guard PROTECTION | OPERATIVE | OPERATIVE | OPERATIVE | OPERATIVE | $8.02 | 76c | $8.78 | NO COST — NO REPLACEMENT NECESSARY | | |
| NON-RESETTING THERMAL PROTECTION | REPLACEMENT NECESSARY | REPLACEMENT NECESSARY | REPLACEMENT NECESSARY | REPLACEMENT NECESSARY | $8.45 | 25c | $8.70 | $8.70 | $3.50 | $12.20 |
| POLYESTER FILL | REPLACEMENT NECESSARY | REPLACEMENT NECESSARY | REPLACEMENT NECESSARY | REPLACEMENT NECESSARY | $8.02 | 33c | $8.35 | $8.35 | $3.50 | $11.85 |

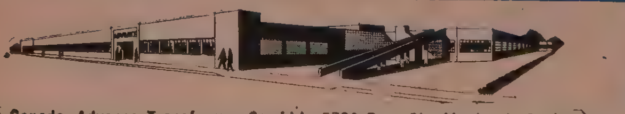
*BASED ON PUBLISHED LIST PRICES FOR 2 LAMP 96" CBM SLIMLINE BALLAST

The superior protection of ADVAN-guard® equipped Fluorescent Lamp Ballasts may cost a little more, but as the chart shows, it is protection that guarantees Fluorescent Lamp Ballast life.

Only ADVAN-guard®, a thermally actuated automatic reclosing protective device, is sealed in the ballast housing and is preset to automatically "trip-out" whenever the Fluorescent Lamp Ballast operates at abnormal temperatures. When heat decreases to normal operating temperatures, ADVAN-guard® resets automatically and the ballast resumes normal operation. If overheating continues, ADVAN-guard® protection continues. Through this continuous protection, the full life of ADVANCE Fluorescent Lamp Ballasts will be realized . . . rated life of ADVANCE Ballasts under normal operating conditions is 10 to 12 years.

End premature destruction and unnecessary ballast labor replacement costs, demand ADVANCE Fluorescent Lamp Ballasts with ADVAN-guard® built-in automatic resetting thermal protection.

*"The Heart of the Lighting Industry"*



**ADVANCE® TRANSFORMER CO.**

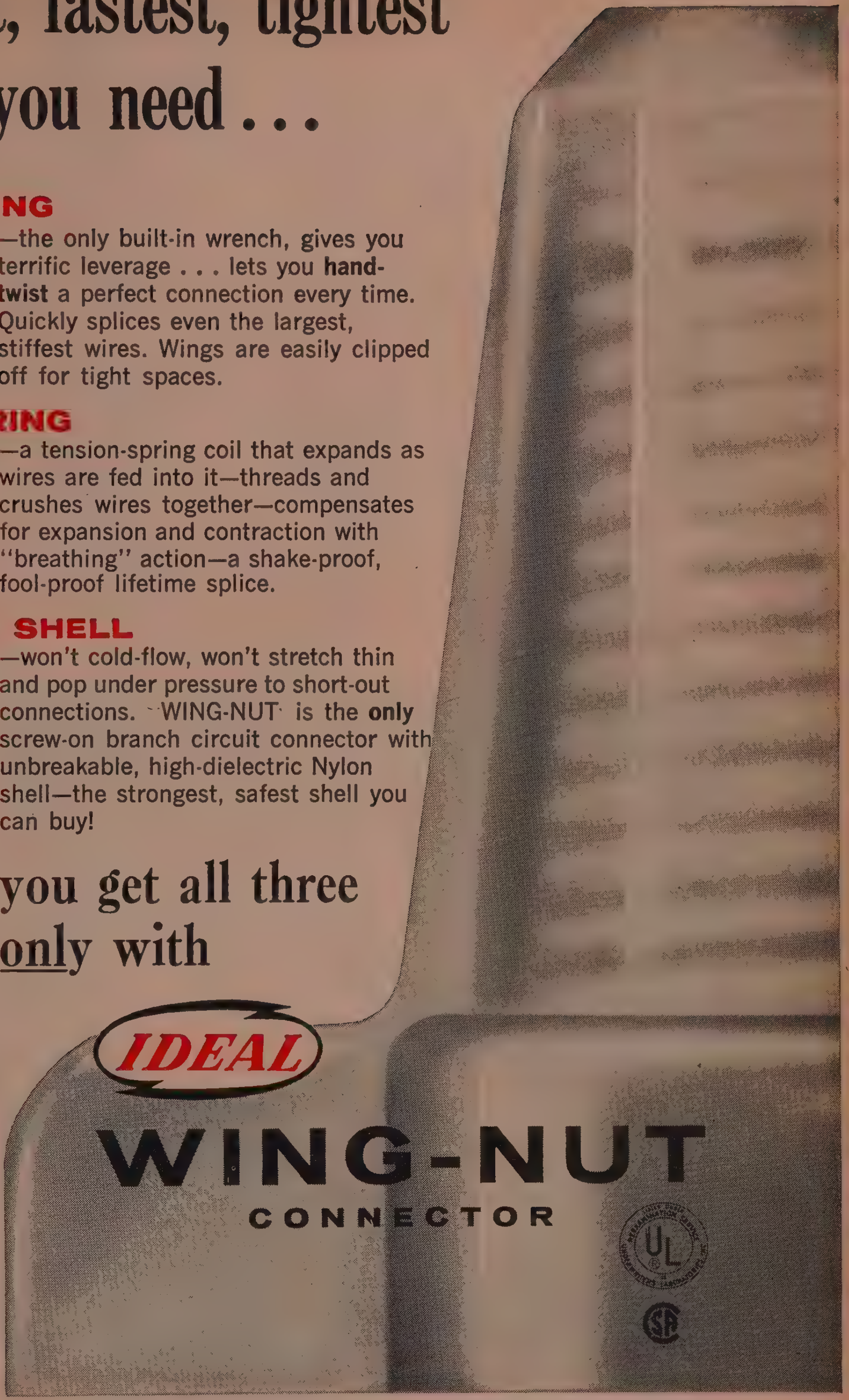
CBM CERTIFIED

WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF FLUORESCENT LAMP BALLASTS

2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

(In Canada: Advance Transformer Co. Ltd., 5780 Pare St., Montreal, Quebec)

# for the easiest, fastest, tightest connections – you need . . .



**the WING**

—the only built-in wrench, gives you terrific leverage . . . lets you **hand-twist** a perfect connection every time. Quickly splices even the largest, stiffest wires. Wings are easily clipped off for tight spaces.

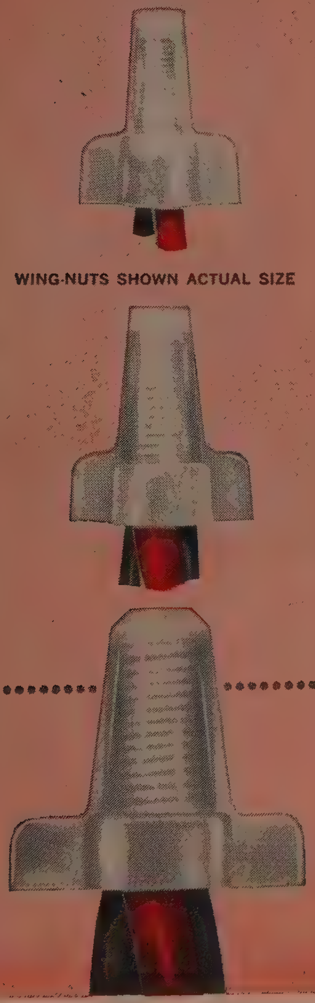
**the SPRING**

—a tension-spring coil that expands as wires are fed into it—threads and crushes wires together—compensates for expansion and contraction with "breathing" action—a shake-proof, fool-proof lifetime splice.

**the NYLON SHELL**

—won't cold-flow, won't stretch thin and pop under pressure to short-out connections. WING-NUT is the **only** screw-on branch circuit connector with unbreakable, high-dielectric Nylon shell—the strongest, safest shell you can buy!

**3 SIZES**
—fit every branch circuit and fixture hanging need!



WING-NUTS SHOWN ACTUAL SIZE

## you get all three only with

## IDEAL

# WING-NUT

## CONNECTOR

*Sold through America's Leading Distributors • In Canada: Irving Smith. Ltd., Montreal*

Please send me a pocket-full of ***FREE SAMPLES***

Fill in and mail coupon, and Ideal will send you a **pocket-full** of WING-NUTS—plenty to let you see why they're America's most popular wire connector.

**IDEAL INDUSTRIES, Inc.,** 1041-H Park Ave., Sycamore, Illinois

Name. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

Company. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

Address. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

City. . . . . . . . . . . . . . . . . . . . . Zone. . . . . . . . State. . . . . . . . . . . . . .

STEBER

STEBER QUARTZLITERS ARE NOW DIE CAST!

New Die Cast STEBER Quartzliters give you truer, full performance from 500 and 1500 watt quartz-iodine lamps. Wide, medium and narrow beam spreads to suit all applications for lighting building facades, signs and billboards, parking areas, sports areas, playgrounds and loading docks. DESIGNED FOR maximum controlled light output, efficient operating temperatures, economical cost ratio (first-cost versus light output) and versatility of application. FEATURES: die cast aluminum/aluminum anodal reflectors/thermal-shock and impact resistant lens/stainless steel hardware/metal to metal cooling—reflector nests in contact with internal fins which conduct heat to outer fin surfaces/available in externally wired yoke mounting (choice of brackets) or swivel mounting with enclosed wiring. Write Steber today for complete catalog information.

**TEBER DIVISION**/ THE PYLE-NATIONAL COMPANY 2700 ROOSEVELT ROAD BROADVIEW, ILLINOIS

ST COAST [illegible] ANDERSON STREET, LOS ANGELES, CALIFORNIA ALSO MANUFACTURED IN CANADA BY: PYLE NATIONAL (CANADA) LTD. CLARKSON, ONTARIO

# CRESCENT

## WIRES & CABLES

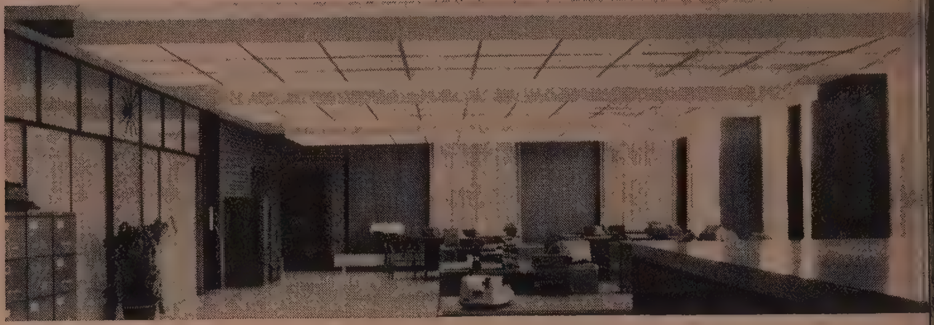
*The Focus is on Quality*

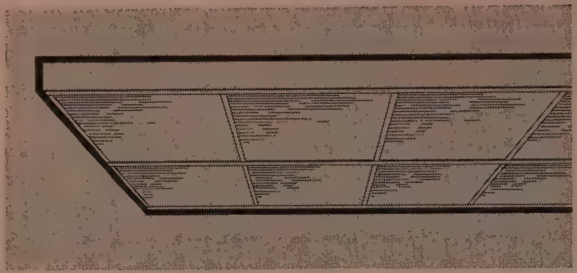
OVER
75
YEARS
EXPERIENCE

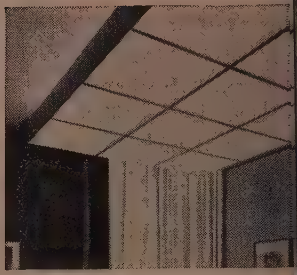
**CRESCENT INSULATED WIRE & CABLE CO., INC.**

TRENTON, NEW JERSEY

# LPI Panelaire series offers design flexibility, visual comfor and high-level lighting







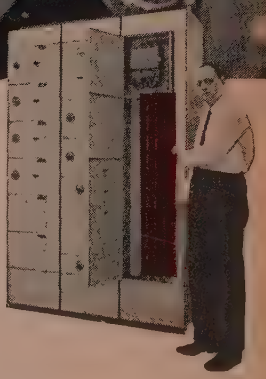
Here's a refreshing way for lighting specifiers to depart from conventional row-type fluorescent lighting installations. The Panelaire series utilizes large floating panels of light to achieve high levels of illumination while maintaining effective control of direct and reflected glare. ☐ Recent photometric measurements have shown that the widely accepted Panelaire complies with the brightness limitations of the "Scissors Curve" as recommended by the Illuminating Engineering Society. In addition, the large area of the light source minimizes reflected glare. ☐ The panels are designed for pendant mounting in square or rectangular patterns on a two-foot module. The bold, massive lines of the Panelaire harmonize with contemporary architectural designs and with existing ceiling structural elements in the case of relighting projects. With its wide choice of diffusers, the series is well suited for stores, offices, banks, foyers, lobbies, and high-bay fluorescent lighting. ☐ Please write LPI for complete Panelaire technical data.

LPI-2-212

**LPI** FLUORESCENT LIGHTING

Lighting Products Inc., Highland Park, Illinois

**polyester busbar sandwich** protects equipment and people...by sandwich-
ng vertical bus between sheets of polyester insulation. Stops spread of unit fault,
locks accidental contact. One of 44 features of the *7700-LINE CONTROL CENTER*
or greatest protection, fastest installation, easiest maintenance available in
grouped control. See your G-E Sales Representative or write for Bulletin GEA-7238 to
ect. 783-22, Schenectady, N. Y. *General Electric Co., Salem, Va. and Plainville, Conn.*



GENERAL ELECTRIC

# High level lighting–down-to-earth costs

**INSTALLATION DATA**

Abolite HMFAU-2400 Alzak aluminum uplight fixtures with 1000 watt color-improved mercury lamps. Mounting height 30 feet, spacing on 20-foot centers. Average maintained footcandle level: 77

**77 footcandles of light with only 50 Abolite fixtures**—Maintenance crews working in this hangar need the best possible light for servicing intricate equipment. In designing the lighting, the choice was between a mercury or fluorescent system Both could provide the required lighting level. But when it came to costs, lighting engineers decided in favor of Abolite fixtures equipped with 1000 watt color-improved mercury lamps. Here's how they figured it:

**Lower initial costs.** Only 50 Abolite fixtures needed as compared with 126 fluorescent reflectors (6 rows of 21 reflectors each). Only 50 mercury lamps needed as compared to 252 eight-foot maximum output fluorescent lamps.

**Lower maintenance costs.** With Abolite, 202 fewer lamps to be serviced. Longer lamp life, too—about 9000 hours average with high lumen output maintained And Abolite fixtures are self-cleaning. Air circulating through their open-top sweeps them clean of dulling dust.

**Lower operating costs.** 52.5 kw connected lighting load for the Abolite mercury system vs. 61.7 kw for the fluorescent system.

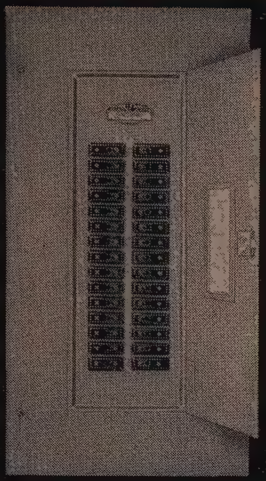
With all these cost-saving advantages, Abolite lighting was the obvious choice. Why not consider this system with Abolite fixtures on your next job? Full information is yours for the asking. Just write:

**ABOLITE Lighting**

THE JONES METAL PRODUCTS COMPANY
*West Lafayette, Ohio*

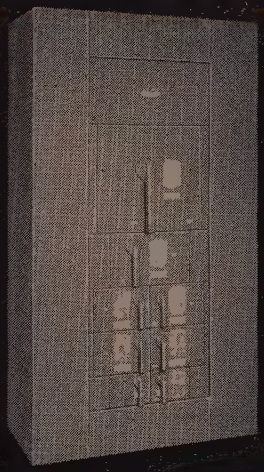
# FRANK ADAM ELECTRICAL EQUIPMENT

## *The Industry's Best Buy In Safety, Performance, Durability*



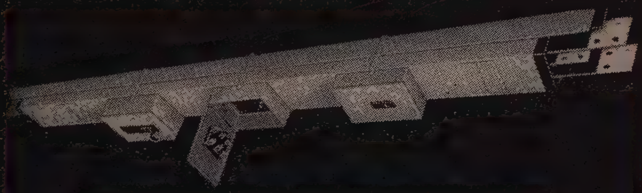
**LIGHTING PANELBOARDS**

Plug-In or Bolt-On Circuit Breaker Types.



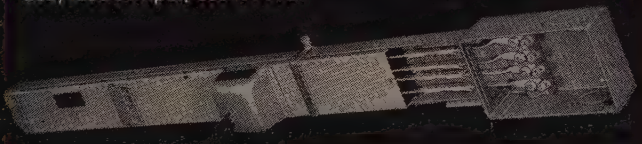
**S-A-W DISTRIBUTION PANELBOARDS**

Last Word in Heavy Duty Fusible Protection.



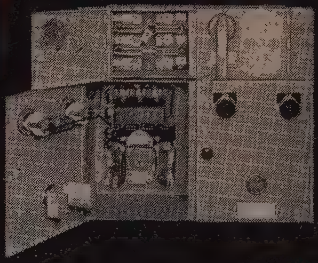
**POWER PLUGIN BUSDUCT**

Plug-In Outlets 10" Centers.
250/1500 Amps., 600-V. AC.



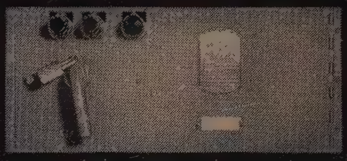
**MIDGET BUSDUCT**

Extends Busduct System for Less Than Wire, Cable and Labor Costs. 100 Amps. Unfused, Fusible or Breaker Plug-In Units.



**NON-COMBINATION**

Starter and Fusible Switch Assembled.



**COMBINATION**

Single Enclosure With Starter and Switch or Starter and Breaker.

**PLUG-IN MOTOR STARTER UNITS**

Plugs into Panelboards or Switchboards. Eliminates Separate Motor Controls.

No matter what the size and complexity of the project—no matter if the need is for the largest switchboard or the smallest safety switch—the Frank Adam name upon it is a warranty of unsurpassed quality and craftsmanship, protection and durability.

Give your clients every benefit in safety, dependability and economy of the "industry's finest"—specify, insist on, Frank Adam Electrical Equipment.

***Write for catalog literature***

**FRANK ADAM ELECTRIC COMPANY**

SINCE 1891

P. O. BOX 357, MAIN P. O. • ST. LOUIS 66, MO.

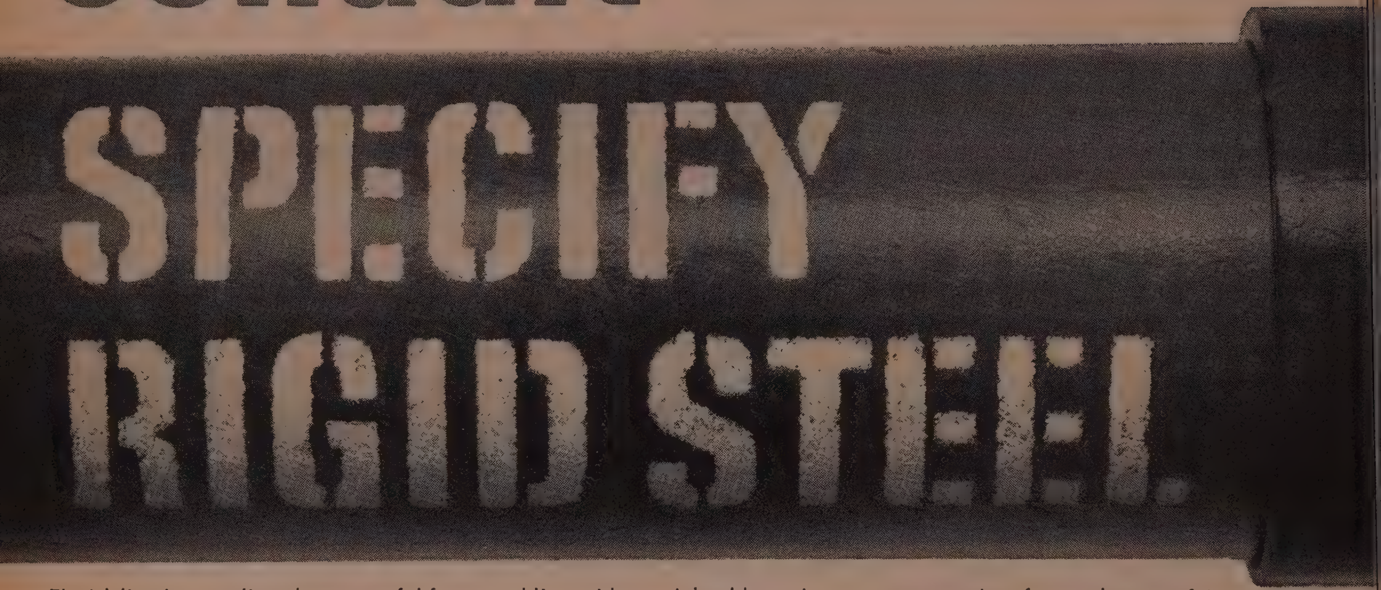
*busduct • panelboards • switchboards • service equipment • safety switches • load centers • Quikheter*

KEEP PACE ELECTRICALLY

THE PRODUCERS' COUNCIL — AFFILIATED WITH THE AMERICAN INSTITUTE OF ARCHITECTS

This mark tells you a product is made of modern, dependable Steel. Steel

# specify safe conduit



Electricity at any voltage is a powerful force, and it must be contained by a strong raceway system for maximum safety. Steel conduit gives that strength—to withstand sudden power surges and overloading from the inside; impact and rough handling from the outside. Rigid steel conduit contains internal damage and protects conductors, insulation and wires from external damage.

Steel conduit offers additional safety because it gives a grounded metallic system, so induced currents are drained off without danger. It is simple to wire and rewire, so circuits can be serviced and changed quickly and easily. It is easy to install, requires few tools, and is easy to bend, cut and thread. It can be installed indoors or out, in dry or wet locations, concealed or exposed, in any hazardous location under all types of atmospheric conditions. You can even bury steel conduit, or run it through or along concrete, without organic covering. For strength, economy and long life, specify time-tested rigid steel conduit.

USS and NATIONAL are registered trademarks

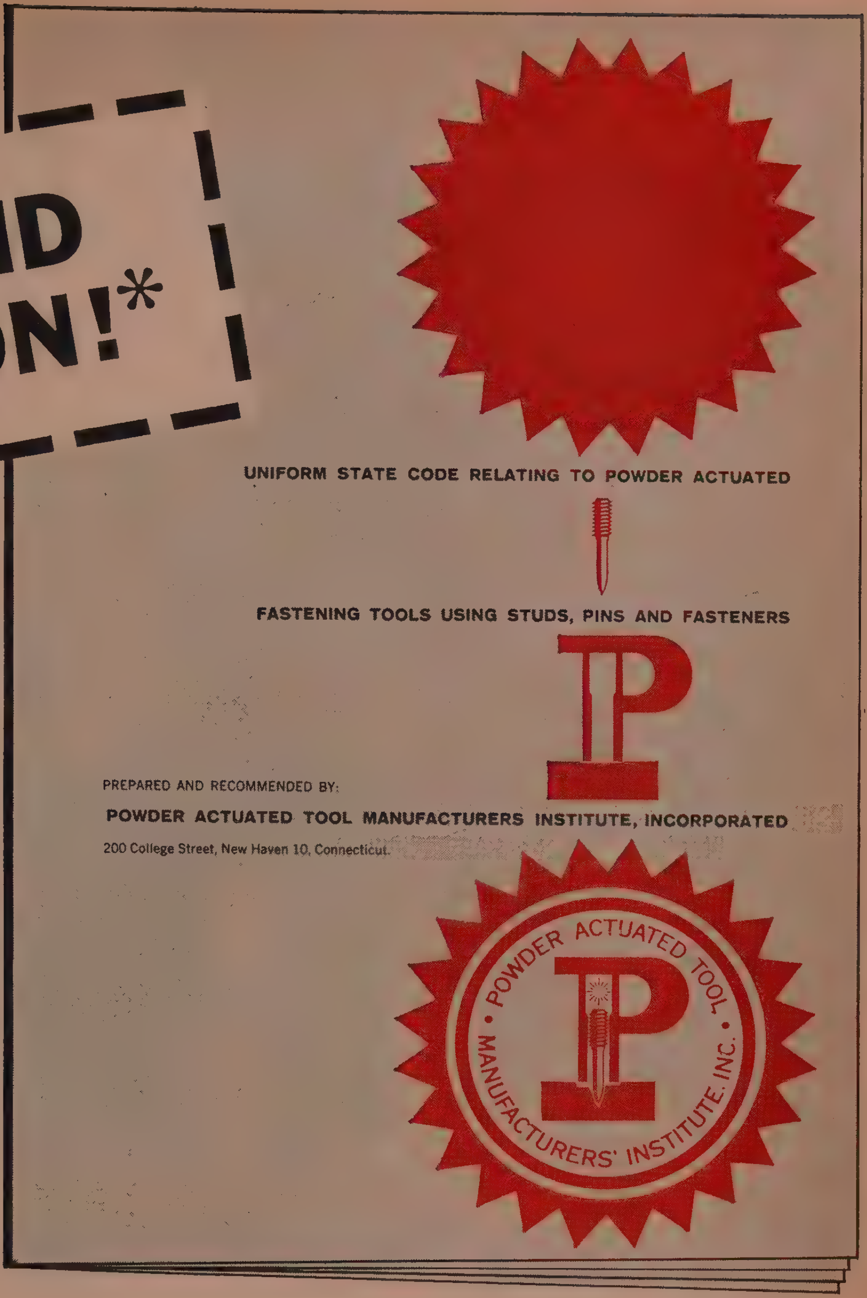
*America's leading Steel pipe manufacturer supplying America's foremost conduit manufacturers*

USS

**National Tube
Division of
United States Steel**

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

SECOND EDITION!*



UNIFORM STATE CODE RELATING TO POWDER ACTUATED

FASTENING TOOLS USING STUDS, PINS AND FASTENERS

PREPARED AND RECOMMENDED BY:

**POWDER ACTUATED TOOL MANUFACTURERS INSTITUTE, INCORPORATED**

200 College Street, New Haven 10, Connecticut.

* *Includes recommended design requirements on low velocity, piston-type tools.*

To: Powder Actuated Tool Manufacturers' Institute, Inc. ECM-8
200 College Street, New Haven 10, Connecticut

Gentlemen: Please send data on Powder Actuated Tools and a copy of the 2nd Edition of the recommended Uniform State Code.

NAME ______ TITLE ______

COMPANY ______

ADDRESS ______

CITY ______ ZONE ______ STATE ______

No representative will call, unless you so request.

For the best in powder actuated tool fastening, rely on these brand names of member companies: **NELSON/OMARK/RAMSET/REMINGTON/STAR**

# Announcing Anaconda

# UniB

**The first high-voltage butyl cable that combines** • Extruded strand shield •
unique process providing uniform, contamination-free blending of ingredient
• Simultaneous extrusion and vulcanization of strand shield and insulation fo
perfect bonding — and a virtually perfect electrode. **These three features o**
**Anaconda UniBlend create a uniformity of dielectric strength previously unattain**
**able, result in a cable:** Smaller in diameter • Lighter in weight • Of greater relia

# lend

## High-Voltage Cable

ty • At lower cost—Anaconda UniBlend is another dramatic advance to come m the finest integrated research and manufacturing facility in the rubber cable d • For complete information, call the Man from conda and ask about new UniBlend. There is no ter high-voltage butyl.

62285

ASK THE MAN FROM
**ANACONDA®**
ABOUT UNIBLEND CABLES

# TOOLS THAT MAKE MORE MONEY!

**ACTUAL SIZE**

**THE NEW POCKET SIZE TOOLS!**

The rugged, light weight No. 607 Indenter for ½" fittings is shown here full size.

## B-M { THE ORIGINAL INDENTER TOOLS / THE ORIGINAL INDENTER FITTINGS

These are the tools and fittings that have revolutionized setting up thin wall conduit. B-M, the Original Indenter Tools have been working efficiently for over 25 years—doing more work easier and lowering installation costs. Now, B-M Indenters have been re-engineered and redesigned to reduce size and weight to increase efficiency and ease of operation. These B-M Indenters with the new patented compound leverage are now only plier size. They are lighter to carry, easier to use and the leverage does the work.

B-M, the Original Indenter Fittings go with B-M Indenter Tools like ham and eggs. Contractors who demand the best always call for the Original B-M Fittings for the soundest, most permanent installations possible. The fittings are concrete tight and vibration resistant. All steel, heavy gauge fittings are heavily bright zinc plated and have been salt spray and acid drip tested for corrosion resistance. Additional features are extra heavy bonding locknuts. Smoothly rounded edges or bushed throat type connectors make fishing easier and prevent damage to insulation.

For fast, safe installation plus complete protection always specify the Original B-M Indenter Fittings and the Original B-M Indenter Tools.

**BM-21B**
½" Connector
**BM-22B**
¾" Connector
**BM-23B**
1" Connector

**BM-41**
½" Coupling
**BM-42**
¾" Coupling
**BM-43**
1" Coupling

**BM-51**
½" Offset Connector
**BM-52**
¾" Offset Connector

*BM PLIER SIZE INDENTERS
BM—No. 609 1" BM—No. 608 ¾"
BM—No. 607 ½"

## BRIEGEL METHOD TOOL CO.

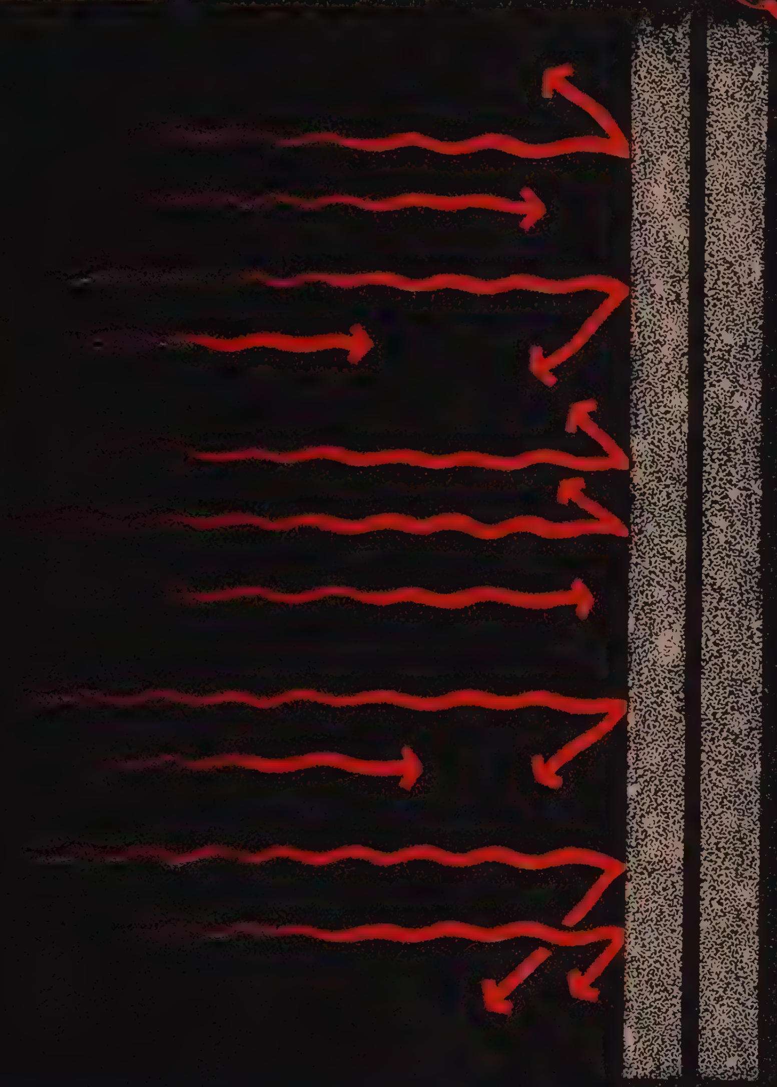
GALVA, ILLINOIS

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

*BM 51 and 52 offsets are not listed as concrete tight.

USED THE MOST FROM COAST TO COAST

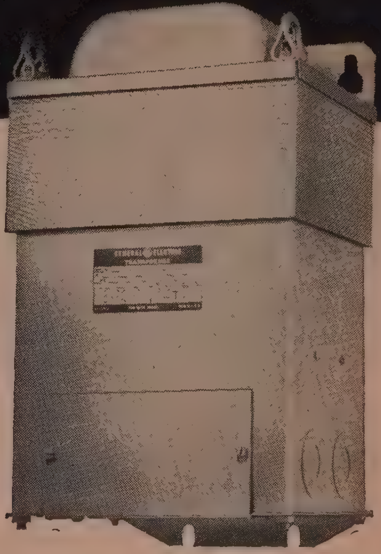
# NEW General Electric QHT Transformers



# HEAT SHIELD

KEEPS WIRING
COMPARTMENT COOL

MEETS NEW
UL
REQUIREMENTS



**EVISED U.L. STANDARDS FOR SAFETY** restrict the type of cable used in making eld connections to listed power transformers. To install such a transformer with w-cost 60C rated cable, the type you commonly use, no surface inside the ring compartment can exceed 60C while the transformer is operating. New IT dry-types pass this test easily . . . thanks to an exclusive G-E shield between e coil and the wiring compartment. MAKE SURE YOUR TRANSFORMERS MEET L. REQUIREMENTS FOR 60C CABLE . . . USE NEW GENERAL ELECTRIC QHT Y-TYPE TRANSFORMERS. Get all the facts from your nearby G-E Sales Office distributor. Or write Section 411-26, General Electric Co., Schenectady 5, N. Y.

*Progress Is Our Most Important Product*

ENERAL ELECTRIC

ACCENT ON VALUE

# HEY, LOOK AT THE NEW

This catalog is really complete!

Includes all the BullDog Marketeer products

Gives ratings, capacities, dimensions, prices

Easiest-to-use catalog I've ever seen . . .

See your nearby I-T-E distributor and get the number of copies you need. Or write I-T-E Circuit Breaker Company, 1900 Hamilton St., Philadelphia 30, Pa.

# I-T-E SPEEDFAX CATALOG!

And Walker Division products, too

Has everything for the construction market

Less cross references, less page flipping

Why not get your own copy!

**I-T-E CIRCUIT BREAKER COMPANY**

B.F.Goodrich
This
KRALOY RIGID PVC CONDUIT
QUALITY PLASTIC PRODUCTS FOR INDUSTRY
Underwriters Laboratories, Inc.
KRALOY/CHEMTROL CO.
is now listed under the label service of Underwriters' Laboratories, Inc.
. . . permitting ABOVE GROUND use*

Already, conduit made of rigid Geon PVC has shown performance superiority in many miles of below ground installations.

Now conduit made of Geon vinyl by Kraloy/Chemtrol, of Santa Ana, California, is included in the National Electrical Code for *above* ground use. Among the many advantages are these:

**Corrosion resistance.** Users report PVC conduit is their best answer to chemical attack by highly corrosive acids and alkaline fumes and vapors.

**Fire resistance.** Conduit of rigid PVC will not support combustion.

**Unaffected by high humidity.** Moisture and water will not penetrate rigid Geon.

**Lower cost.** Installation is quick and easy.

For specific information on the use and limitations of PVC conduit, consult the new National Electrical Code, *Article 347*, or write B.F.Goodrich Chemical Company, Department AL-4, 3135 Euclid Avenue, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

*Under provisions of revised National Electrical Code, Section 347.

**B.F.Goodrich Chemical**
a division of The B.F.Goodrich Company

Geon
VINYLS
REG. U.S. PAT. OFF.

WIREMOLD®
ELECTRIC IDEAS

PREPARED EACH MONTH FOR ELECTRICAL CONSTRUCTION AND MAINTENANCE TO BRING IDEAS, NEWS AND HELPFUL INFORMATION TO ELECTRICAL MEN

63rd YEAR

AUGUST 1962

IXTURE SHOWROOM WIRING ........ FIRST PAGE
ODE COMMENTS ........ FIRST PAGE
RODUCT OF THE MONTH ........ SECOND PAGE
QUIZ CORNER ........ SECOND PAGE
COUPON FOR FREE ITEMS ........ SECOND PAGE
ENGINEERED SPECIALS ........ FOURTH PAGE
NOTEWORTHY ........ FOURTH PAGE
WORTH READING ........ FOURTH PAGE
PRACTICAL TIPS ........ FOURTH PAGE

# Wiremold Economical for Wiring Fixture Showroom

Surface wiring systems prove less costly, more attractive in new lamp and fixture showroom

In the highly competitive field of fixture and lamp sales the importance of in-use displays cannot be overstated. Most buyers are more interested in how the fixture looks when lighted than in its lights-off appearance.

Recognizing this, more and more displays have turned to multi-outlet systems to assure plenty of conveniently located receptacles.

Typical of this concept is the warehouse and showroom building of Shemitz Lighting Co., Milford, Conn.

To provide for the needed outlets in as inconspicuous and flexible a manner as possible, it was decided

*continued on third page*

EXPOSED RACEWAYS blend with over-all ceiling decor in this modern fixture showroom. Wiremold systems proved both economical and practical for this application.

## Code Comments

### Lighting Branch Circuits

**Q.** *May additions be made to existing general lighting branch circuits?*

**A.** Section 220 (2) (d) (Existing Installations) states: "Additions to existing installations shall conform to the following:

"(1) Dwelling Occupancies. New circuits or extensions to existing circuits may be determined in accordance with Paragraphs 220-2(a or b); except that portions of existing structures not previously wired, or additions to the building structure, either of which exceeds 500 square feet in area, shall be determined in accordance with Paragraph 220-2(a).

"(2) Other Than Dwelling Occupancies. When adding new circuits or extensions to existing circuits in other than dwelling occupancies, the provisions of Paragraphs 220-2(a or b) shall apply."

### Walk-In Refrigerators

**Q.** *Is it permissible to use surface metal raceways in walk-in refrigerators?*

**A.** No. Article 352-1 specifies: "Surface metal raceway may be installed in dry locations."

A walk-in refrigerator could be classified as a damp location according to Article 100 of the National Electrical Code, which defines damp location as: "A location subject to a moderate degree of moisture, such as some basements, some barns, some cold storage warehouses, and the like."

WIREMOLD®

*Advertisement*

## Quiz Corner

*Questions for this department are taken from inquiries received from the field. Your questions are welcome; indeed, they are necessary if this department is to serve you with worthwhile information. Address:*

Quiz Corner
The Wiremold Company
Hartford 10, Conn.

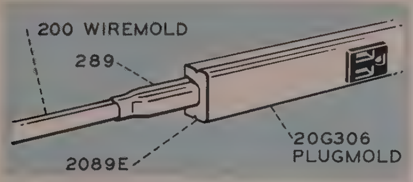
***Q.*** *Is there a 2-gang switch and receptacle box available for Wiremold 1000?*

***A.*** Yes, 1048-2 is available on special order.

***Q.*** *Do you have a duplex 2127D lumiline receptacle?*

***A.*** No, but two 2127D can be used back to back.

***Q.*** *How do I connect Wiremold 200 to Plugmold 20G306 horizontally?*



***A.*** Through the use of a 2089E end reducing connector and a 289 reducing connector.

***Q.*** *What size quarter round does the 2617T accommodate?*

***A.*** With cover twistouts removed and base broken at scores, the 2617T will accommodate 3/4″ quarter round molding.

***Q.*** *What is the maximum number of circuits that can be used in Wiremold 2100?*

***A.*** Maximum number of circuits allowed in 2100 or any raceway is determined by the maximum number of conductors allowed in the raceway. No. 2100 has a maximum capacity of 14 No. 12 TW conductors without devices. This would permit seven two-conductor circuits, or a total of nine circuits where a combination of 2- and 3-wire circuit arrangement is used.

***Q.*** *Is there a 215 tee for Wiremold 200?*

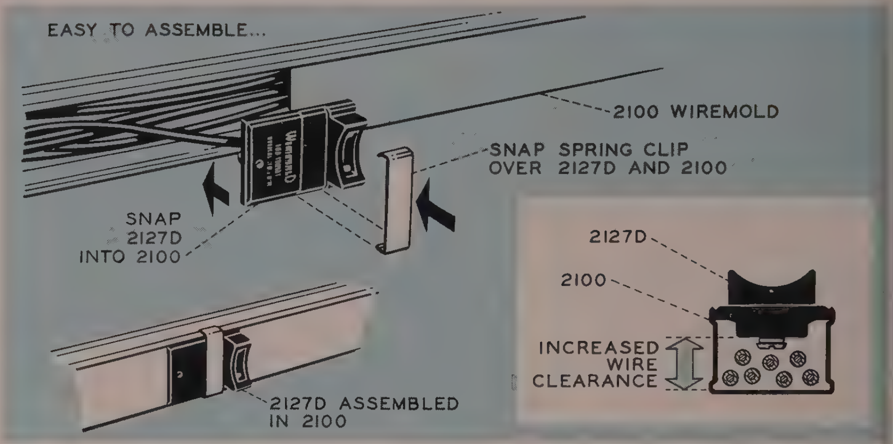
***A.*** No, use the 228 adjustable junction box.

## Product of the Month

### Improved lumiline receptacle available

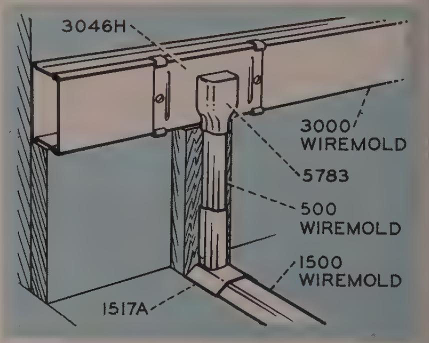
The redesigned 2127D Lumiline Single Receptacle has many refinements designed to make it simpler to use.

The neck of the lamp holder has been made deeper, providing more clearance between lamp and reflector. Fastening to the raceway has been streamlined — simply put the 2127D in place and fasten with spring clip furnished. The terminal has been redesigned to provide greater wire clearance and permit connection by through wiring.



## Correction

In the July issue, art work illustrating connection of Pancake® 1500 on floor to Wiremold 3000 above ¾″ x 5½″ wood base incorrectly labeled the short run of 500 Wiremold as 200 Wiremold. Corrected drawing follows:



**WIREMOLD ■ HARTFORD 10, CONN.** E2-8

Gentlemen: Please send free the checked items

NAME ____________________
COMPANY ____________________
ADDRESS ____________________
____________________

☐ Contractors' Electrical Equipment reprint
☐ Electric Ideas, July, 1962
☐ Electric Ideas, June, 1962
☐ Wiring Guide (Catalog 22)

WIREMOLD®

*Advertisement*

# Wiremold Economical For Wiring *continued from first page*

to use Wiremold 3000 as a feeder and subfeeder system and Plugmold 2000 with three-wire duplex switched outlets at 30-in. intervals.

A 400-amp. service entrance was provided, breaking to a power panel and to a separate lighting panel for the 18 display circuits.

The lighting panel was serviced with 120/208-v., 3-phase, 4-wire, 100-amp. service protected by three 50-amp., 2-pole; two 20-amp., single pole; and two 30-amp. single pole breakers.

From the lighting panel, nine No. 6 conductors were fed through conduit to a run of 3000 in the basement. The encased wires continue up the basement wall to the selling floor above. Because the structure overhangs the foundation approximately 14-in., a short run was required along the floor to the wall.

From the wall, the 3000 is exposed on the ceiling. Branch circuits were tapped into Plugmold 2000 from the ceiling runs. Each circuit is protected by a 20-amp., single pole circuit breaker mounted two to each 3046KD housing directly in the raceway.

The Plugmold® runs also are exposed along the ceiling. Fixtures are plugged directly into the Plugmold receptacles so that their cords are virtually unnoticeable. Floor lamps are connected to the outlets either directly or by the use of temporary extension cords.

To permit switching sections of the individual circuits, the contractor — New England Electric Construction Co., Inc., Bridgeport, Conn. — wired pull switches into the 3000 at various intervals.

The contractor reports that not only were the Wiremold systems the best for lighting of fixtures in the showroom, but that they proved less costly than if installation had been made with concealed wiring.

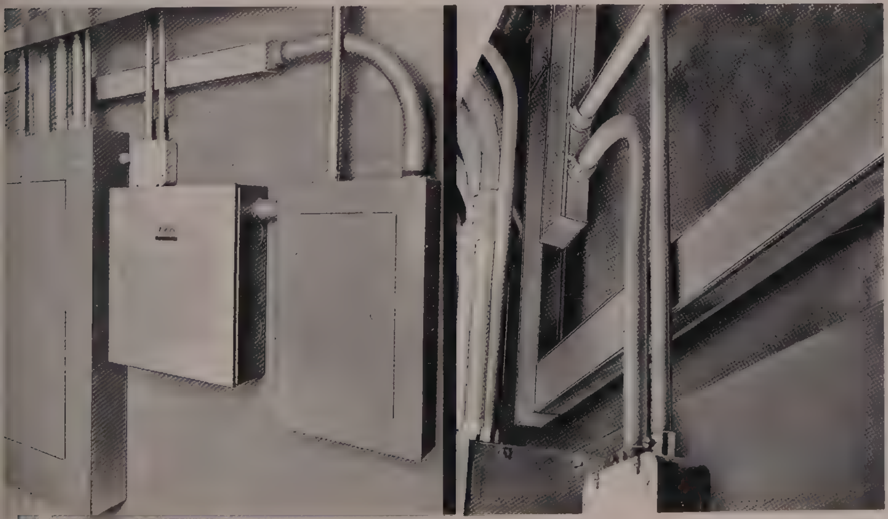
The power panel services the heat pump, basement lighting and other auxiliary services. Power is brought to the showroom floor through a run of 3000 which is terminated after a short run up the showroom wall.

WIREMOLD®

SHOWROOM and warehouse is of curtain wall and solid masonry construction. Surface wiring systems were chosen for ease of installation and flexibility.

WIREMOLD 3000 risers come from basement panels. Left run is from lighting panel, right run from power panel.

CIRCUIT BREAKERS mounted in 3000 raceway protect branch circuits. Plugmold 2000 was used to assure enough outlets.



CONDUCTORS from power panel (left) and lighting panel (right) are carried to Wiremold risers. Photo on right shows detail of hook-up.

*Advertisement*

# Engineered Specials

## Two-piece corner coupling developed for partitions

**PROBLEM:**

To be able to install and remove interior partitions at will and to provide electrical outlets on the partition.

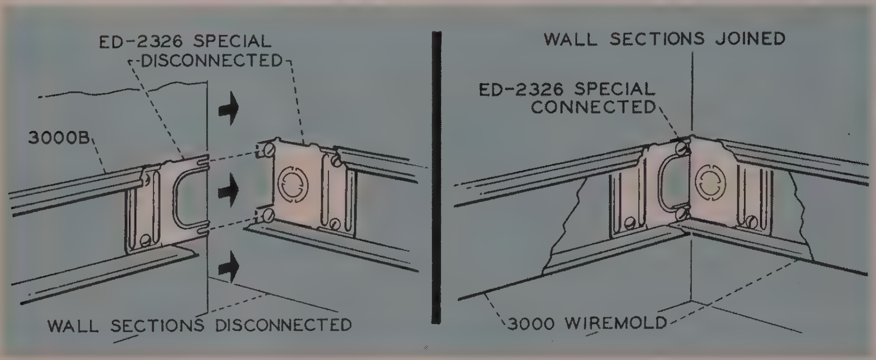
**SOLUTION:**

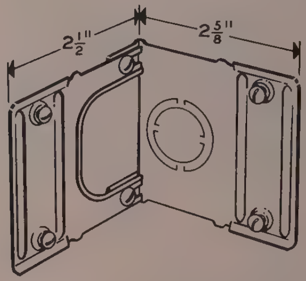
Plugmold 3000 was used for perimeter wiring and a special, 2-piece 3017TC Internal Corner Coupling was developed.

**DISCUSSION:**

The 2-piece 3017TC with separable legs made it possible to remove or install any partition with its Plugmold intact.

All that is needed to remove the wall is to remove the elbow cover, unscrew the two legs of the coupling, cut the wires, and carry off the partition. The perimeter wires are then re-connected. The reverse is done to install the partition.





# Noteworthy

### Three pole switch and box

A single fitting for Wiremold 200, 500 or 700 is available for use with a three pole switch.

The 57240B switch and box is furnished with a standard three-pole switch. The cover has twist-outs for the three raceway series on each end and each side, in position to permit running Wiremold close to interior trim.

The recently-developed 57240B is an illustration of the continual refinement of the Wiremold line of fittings to make them more convenient for you to use.

# Worth Reading

Check coupon on second page for copies of listed item.

*Multi-Outlet Raceway Distributes Power to Appliance Sales Area,* Contractors' Electrical Equipment, July, 1962. A case history discussion of the wiring of a large appliance center in a new food-and-department store.

# Practical Tips

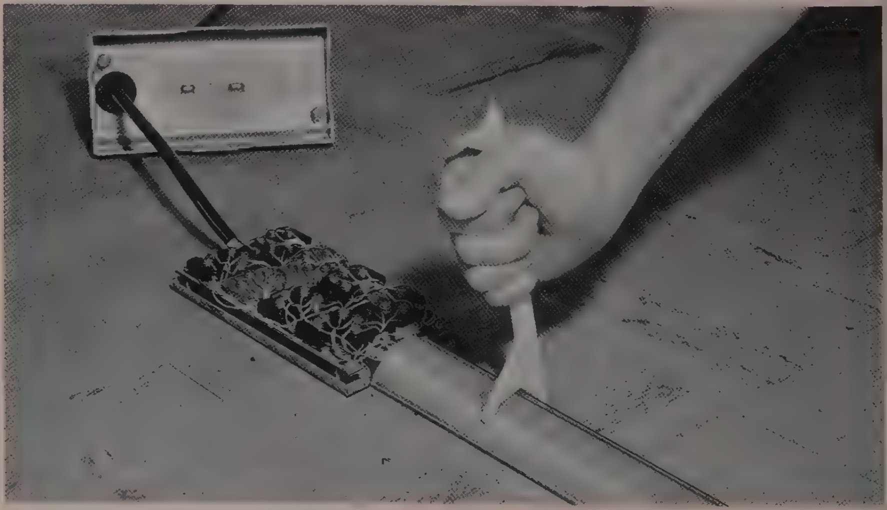
## Cover removal tool aid in maintaining overfloor systems

The 656 Cover Removal Tool is designed to speed up the removal of the cover from Pancake 1500 and Pancake 2600 overfloor systems without twisting, kinking, or bending the cover section.

Each end of the tool is made to fit one of the two raceways and is stamped with the series number. It is easy to use and small enough to fit in any tool box.

To use the 656 tool, start at one end of the cover, or where the cover joins the fitting, and progress toward the opposite end. Firm and steady pressure should be applied, but care should be taken not to force the cover.

After removal, the cover may be re-installed by the normal method.



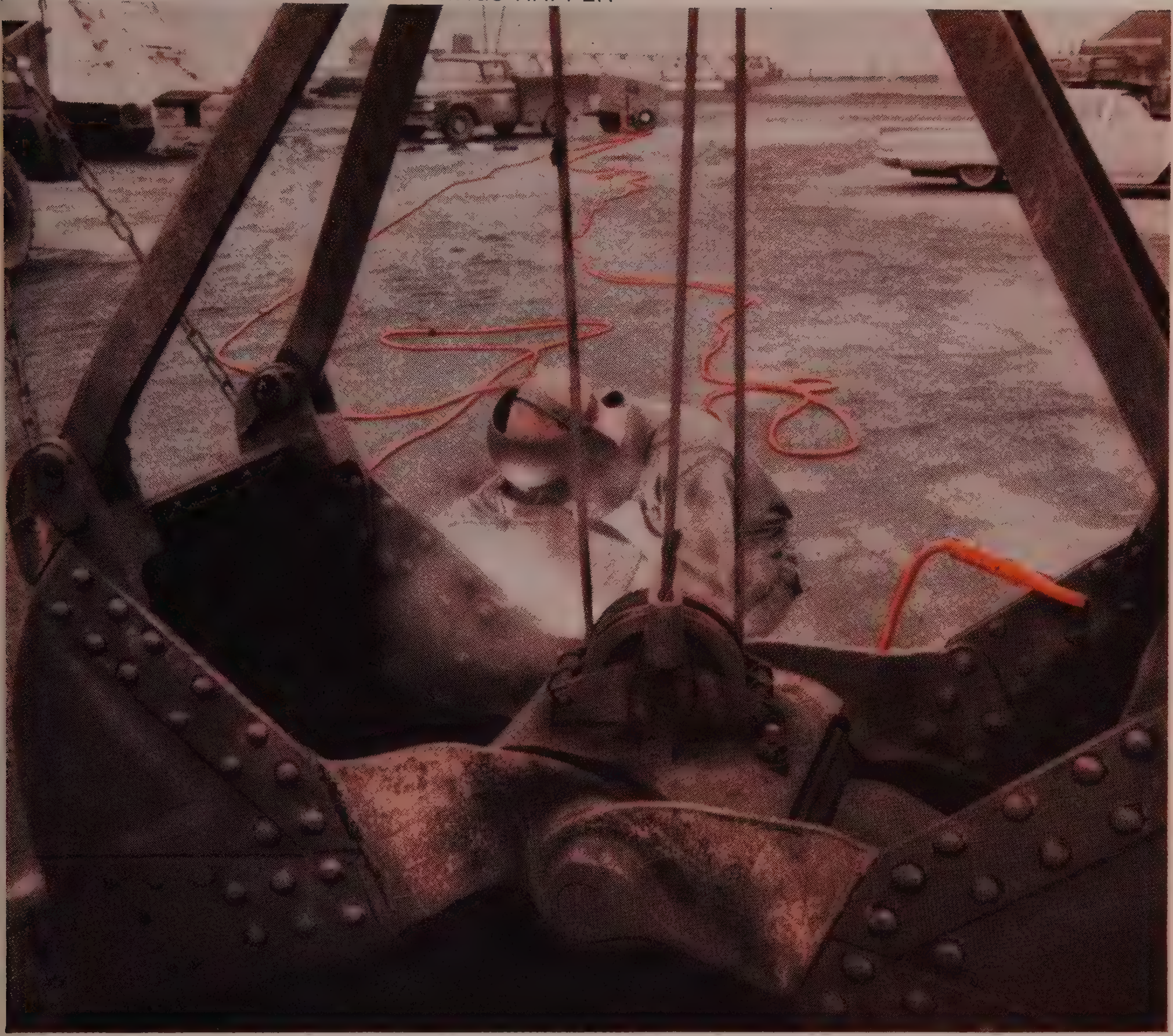
**WIREMOLD®**

HARTFORD 10, CONNECTICUT
In Canada: Conduits National Co., Ltd.
Toronto 2, Ontario

All WIREMOLD products are sold through electrical distributors — your best source for all electrical products.

*Advertisement*

NAUGATUCK CHEMISTRY MAKES THINGS HAPPEN



# Look what's new in welding cable!

**PARACRIL OZO** Nobody wants to trip over or accidentally cut an electric cable. A welding cable, particularly, carries a potential hazard at the business end, a high amperage, and a loss of dollars if service is interrupted.

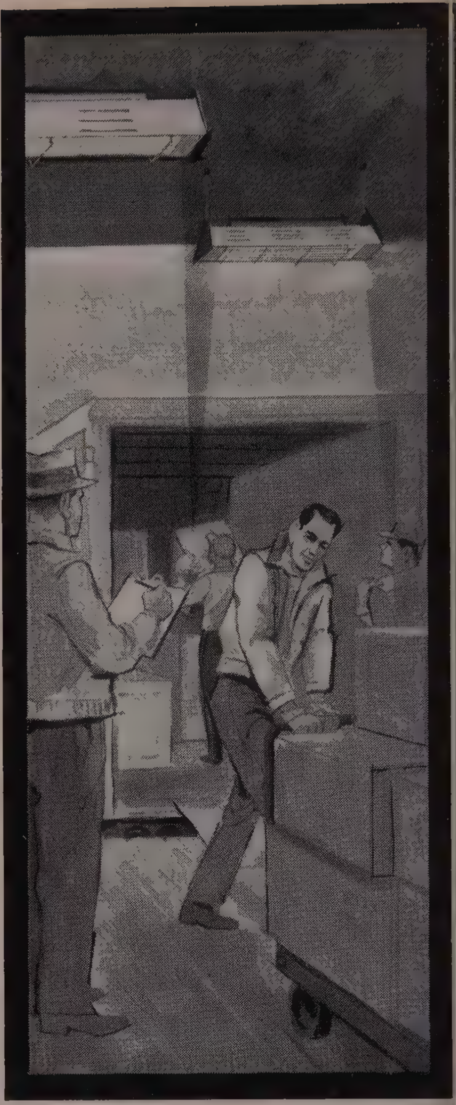
Carol Cable Company of Pawtucket, Rhode Island, found an excellent solution to this constant hazard by jacketing its cable with tough, colorful PARACRIL® OZO. (Carol calls it VU-TRON 7.) The brightest, *lasting*, orange color calls instant attention to the cable even amid a profusion of other hose and cables such as found on a construction site. What's more, this unique blend of nitrile rubber and vinyl gives far superior resistance to attack from weather, ozone, oils and other solvents, and has outstanding resistance to cutting and abrasion. These new cables actually have five times the abrasion resistance of standard synthetic rubber after being exposed to oil! They're more flexible, too.

In short, PARACRIL OZO makes good welding cable better—safer, more durable than ever. And there's a good chance it can improve your product as well. If you'd like to combine toughness, oil and chemical resistance, and excellent color retention, check with your Naugatuck Chemical representative today.

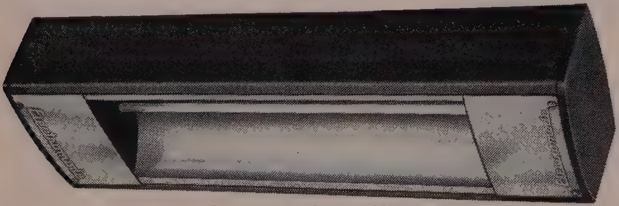
**Naugatuck Chemical**

DIVISION OF UNITED STATES RUBBER COMPANY...DEPT. 834PA ELM ST., NAUGATUCK, CONN.

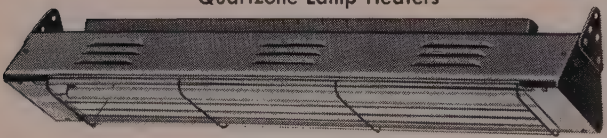
**DIST. OFFICES:** Akron • Boston • Chicago • Gastonia • Los Angeles • Dallas • New Brunswick, N. J. • **CANADA:** Naugatuck Chemicals, Elmira, Ont. • **CABLE:** Rubexport, N.Y.



# ®*Electromode* QUARTZONE ELECTRIC RADIANT HEATERS



Quartzone Lamp Heaters



Quartzone Tube Heaters

**COMPLETE LINE:** Features more than 400 types, models and capacities of heaters and heating systems, all with exclusive Safety Grid. The solution to your heating problem is in the Electromode catalog.

▶ **For complete specifications and literature write to:**

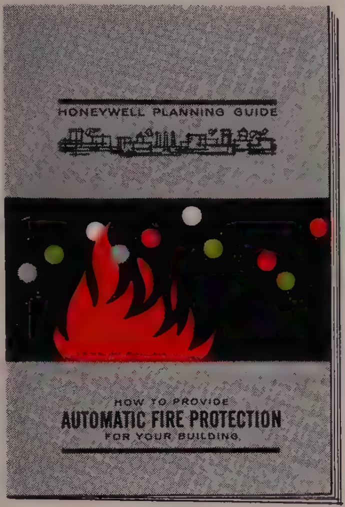
Perfect for indoor and outdoor heating. Electromode Quartzone infrared heating is totally different from other types of heating in both principle of operation and sensation of warmth that is enjoyed. It is the nearest thing to natural sunlight, and is transmitted in much the same way. Infrared rays have a particular and useful characteristic. They speed through the air to heat only the persons or objects directly—and not the surrounding atmosphere. No heat is wasted enroute. That is why these heaters are often the only economical method of providing suitable warmth to persons in certain large and exposed areas. Some areas are impossible to heat satisfactorily otherwise. Infrared heaters therefore open up a wide avenue of new applications for controlled spot heating in home, farm, commerce and industry needs.

**ELECTROMODE** *division of Commercial Controls Corp.*
DEPT. ECM 82 ROCHESTER 3, NEW YORK

# FREE! Building System Planning Guides for your clients

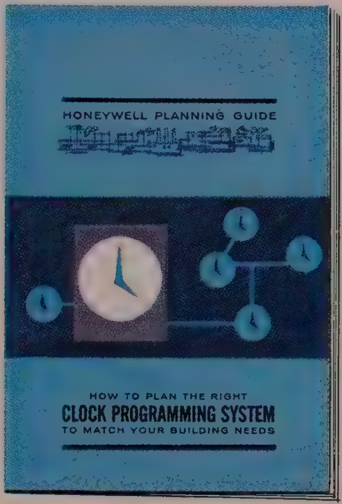
**Four, new, authoritative guides designed to help you advise your clients on how to get the best electrical systems when they build or remodel.** Guides cover new techniques and developments. They tell how to avoid early obsolescence and high maintenance costs. They point out the advantages of a quality installation. Give you new background information. And they're all from Honeywell—the only company that designs, builds, installs and guarantees all these systems.

Mail the coupon now for your Planning Guides. Check them all if you wish.


HONEYWELL PLANNING GUIDE

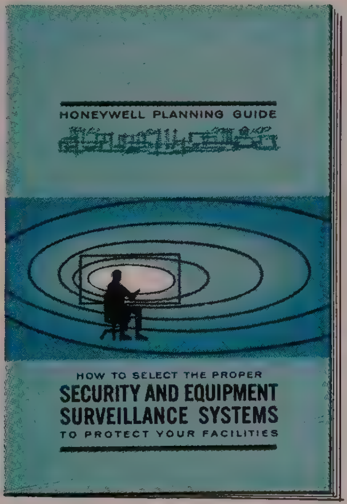
HOW TO PROVIDE
AUTOMATIC FIRE PROTECTION
FOR YOUR BUILDING

**Explains** principles of automatic fire detection and alarm, how to best protect lives and property. Relates economics of systems to fire insurance rates. Covers new equipment, ways to cut costs.


HONEYWELL PLANNING GUIDE

HOW TO PLAN THE RIGHT
CLOCK PROGRAMMING SYSTEM
TO MATCH YOUR BUILDING NEEDS

**Gives** complete facts on modern systems. Tells how clocks can ring bells, turn lights and other equipment on and off on schedule. Where systems can be used to increase efficiency in all types of buildings.


HONEYWELL PLANNING GUIDE

HOW TO SELECT THE PROPER
SECURITY AND EQUIPMENT SURVEILLANCE SYSTEMS
TO PROTECT YOUR FACILITIES

**Tells** why systems can save up to $25,000 or more yearly in industrial plants, how new electronic and sonic devices can inexpensively protect everything from a small area to an entire building.

HONEYWELL PLANNING GUIDE

HOW TO PLAN A
PREVENTIVE MAINTENANCE PROGRAM
TO PROTECT YOUR BUILDING
CONTROL INVESTMENT

**Explains** A, B, C's and benefits of maintenance. Helps clients select the best preventive program for their needs. Covers different, new contract programs that can often provide better maintenance service at lower cost.

**Honeywell**

H HONEYWELL *First in Control*

CHECK GUIDES YOU WISH. MAIL COUPON.

☐ Automatic Fire Protection

☐ Security and Surveillance

☐ Clock Programming Systems

☐ Preventive Maintenance Programs

**To: Minneapolis-Honeywell, Dept. EC8-67**
**2753 Fourth Ave. South, Minneapolis 8, Minn.**

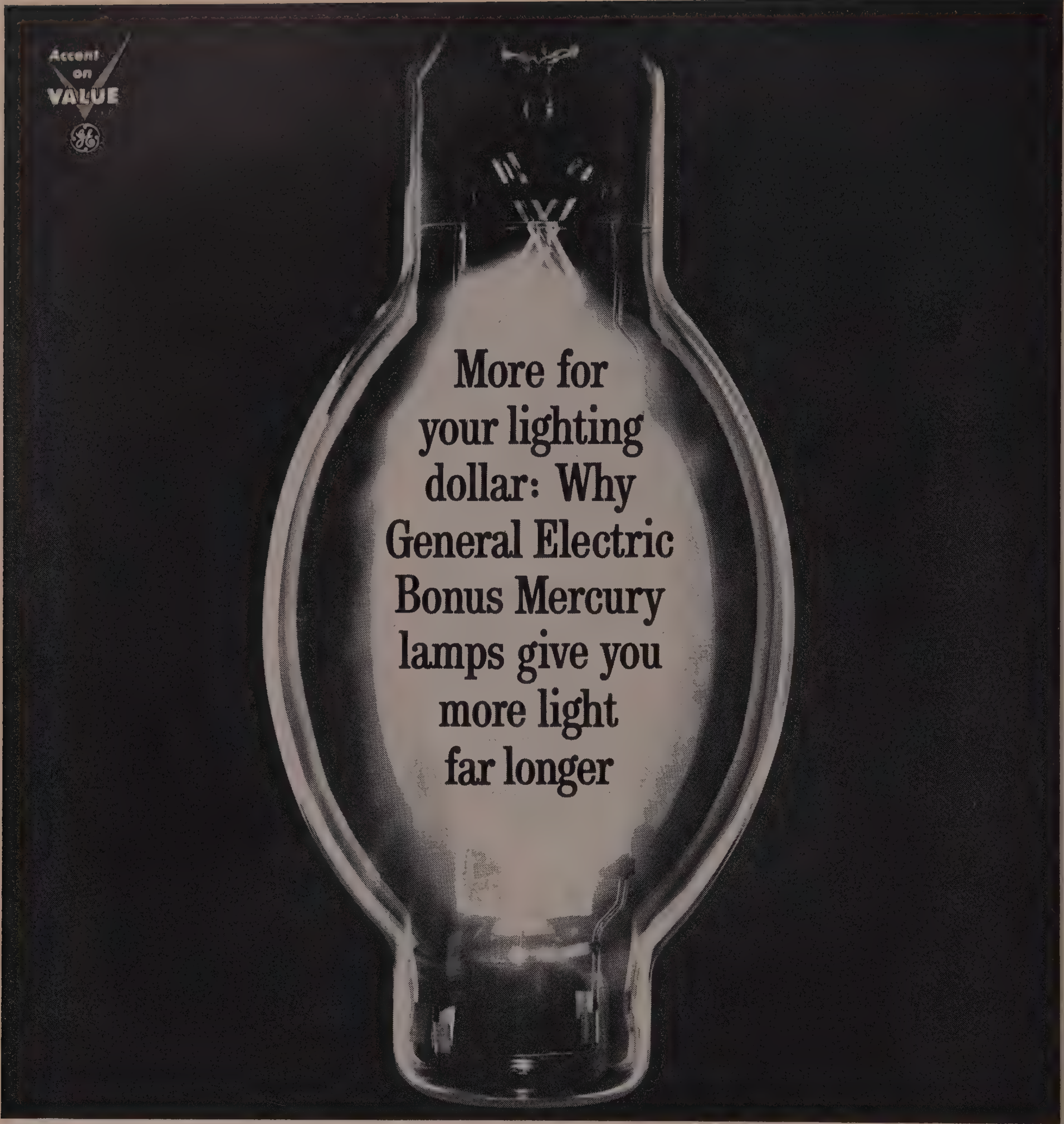
Please send me the following Planning Guides.

Name____________________

Company____________ Title____________

Address____________________

City____________ Zone____ State________



# More for your lighting dollar: Why General Electric Bonus Mercury lamps give you more light far longer

**STRENGTH WITHOUT DIMINISHED LIGHT:** General Electric engineers designed the arc supports of Bonus Mercury lamps for maximum strength, yet at the same time for minimum interference with light output. How strong? General Electric is so confident of these simple but rugged arc supports that if there is any structural failure at any time in normal service before the end of rated life a replacement lamp will be supplied at no charge.

And during 12,000 hours of useful life, you get more light, too, because of the unusual design of the arc tube inside Bonus Mercury lamps. It's different—actually whitens the arc tube instead of darkening it as older designs did—and still do. That's why General Electric can promise—and deliver—extra hours of better life. Extra? Well, we mean that these lamps deliver nearly 50% more light at 6,000 hours, compared to older designs.

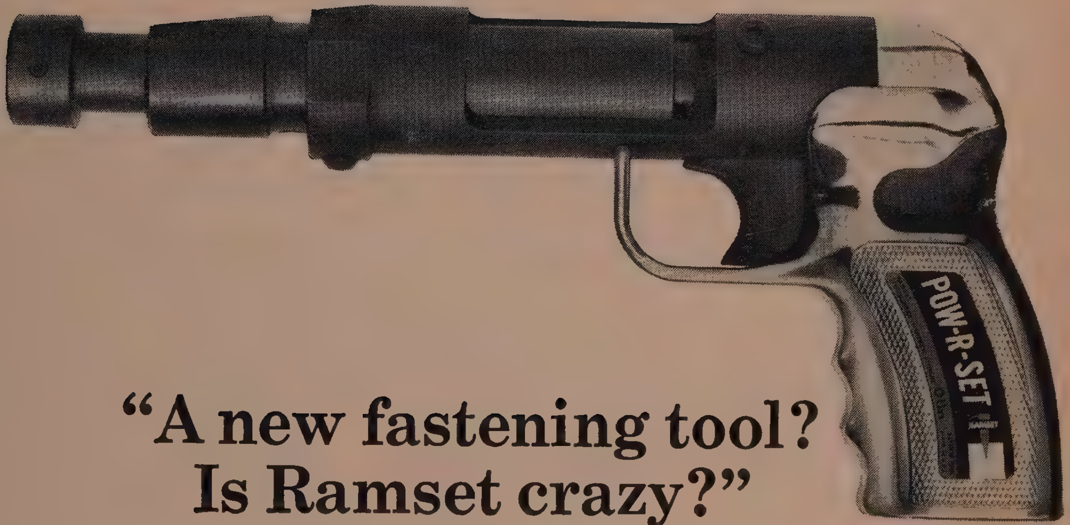
Your General Electric salesman or agent has more facts. General Electric Company, Large Lamp Department C-228, Nela Park, Cleveland 12, Ohio.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

**GET THE MOST LIGHT AND LIFE** from 40-watt fluorescents. General Electric engineers set a new standard with the New General Electric F40 for a mass-produced, nationally distributed lamp. It has still to be matched in terms of extra light and life. Lamp buyers who want the best in light are buying the New G-E F40.

**EXTRA SHOCK AND VIBRATION RESISTANCE** for PAR and R spotlights comes because General Electric engineers designed an extra glass bridge to hold lead wires and filament accurately in position. Gives better beam control, too, and the sealed-in reflectors reduce or eliminate problems and cost of cleaning and maintenance.



# "A new fastening tool? Is Ramset crazy?"

We haven't lost our senses.

Our Jobmaster,® the industry standard, is not being replaced. We've designed a totally different tool, for different kinds of work.

Good old Jobmaster for *medium* and *heavy* duty fastenings.

New Pow-R-Set* for *light* duty fastenings.

Like anchoring aluminum window tracks.

Setting metal channel runners for movable wall systems or for prefabricated exterior panel systems.

Or fastening *any* light gauge metal or wood to concrete, block, or structural steel.

Pow-R-Set works on an entirely different principle than Jobmaster. Both harness the efficiency of powder actuation. But instead of shooting, Pow-R-Set *hammers* the fastener into the work. In one surge.

The powder charge drives a piston inside Pow-R-Set's barrel. The piston sets the fastener.

Over-penetration and ricochet are virtually impossible.

We've made a wide assortment of interchangeable muzzle bushings to speed special applications.

If we don't have the one you need, our custom shop will make it.

The fastest way to see and try new Pow-R-Set is to call your local Ramset dealer. He's listed in the Yellow Pages, under "Tools."

*Trademark

**Ramset®** WINCHESTER-WESTERN DIVISION **Olin**
285-H Winchester Ave., New Haven 4, Conn.

REGULAR 66' ROLLS
Also available in
"JOB-SIZE" 44' ROLLS

# Now the famous J-M Dutch Brand® Dispenser comes loaded with 11 different tapes!

COLD WEATHER

BLUE VINYL

SILVER VINYL

RED VINYL

### TEN IMPORTANT ADVANTAGES OF THIS NEW DISPENSER!

1. Permanently shielded cutter.
2. No moving parts to snag hands, clothes.
3. Can't clog.
4. "Tape-and-tear" with one hand.
5. Special "grip-strip" for faster starting.
6. Contains finest plastic electrical tape made.
7. Preloaded, ready to go.
8. Protects tape against dirt, grease.
9. Big center hole for easier handling.
10. No extra cost.

GREEN VINYL

YELLOW VINYL

ORANGE VINYL

WHITE VINYL

a few short months, J-M Dutch
rand Plastic Tape in its handy dis-
enser has become the talk of the
ectrical industry. It is the handiest
ape-and-dispenser combination
vailable anywhere . . . the tape-and-
ear device that makes a wide variety
f jobs so much faster and easier.

Now—Johns-Manville offers you a
hoice of eleven different plastic elec-
rical tapes packaged in this great
ispenser unit. Here they are:

- **Black plastic electrical tape in standard 66′ rolls.**
- **Black plastic electrical tape in "job-size" 44′ rolls.**
- **Special Cold-Weather plastic electrical tape in standard 60′ rolls.**
- **Vinyl tape in eight colors—red, green, orange, blue, yellow, brown, silver and white—available in 66′ rolls.**

All of these J-M Dutch Brand tape-and-dispenser units can help you do your job with less effort and more economy! Get the full story from your Dutch Brand Distributor. Or write Johns-Manville, Box 359, New York 16, N. Y. In Canada: Port Credit, Ont. Cable: Johnmanvil.

BROWN VINYL

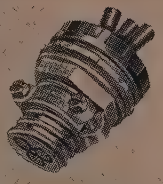
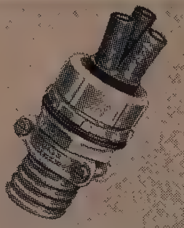
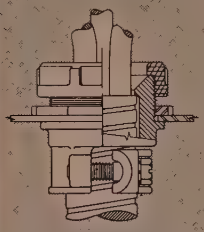
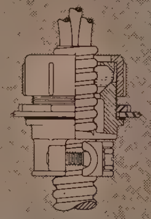
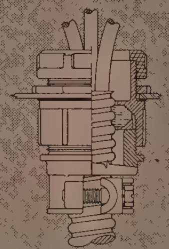
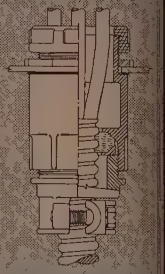
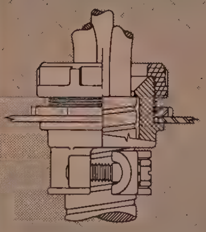
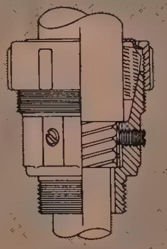
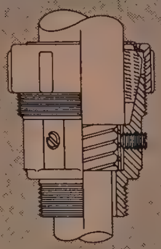
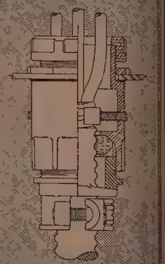
HNS-MANVILLE
JM
ODUCTS

**JOHNS-MANVILLE**
DUTCH BRAND TAPE

# OZ HAS A

## TO YOUR ARMORED

### *INTERLOCKED—
### CONTINUOUS—
### JACKETED—
### NON-JACKETED

| | NON-WATERTIGHT<br>For standard IPS knockout, slip hole or D & T entrance. | WATERTIGHT<br>Gland type: For standard IPS knockout, or slip hole. | WATERTIGHT<br>Gland type, with Compound Chamber, for standard IPS knockout, slip hole, D&T entrance. | WATERTIGHT<br>Upright, with Com<br>pound Chamber, fo<br>standard IPS knockout<br>slip hole, D&T entrance |
|---|---|---|---|---|
| **NON-JACKETED INTERLOCKED ARMORED CABLE** | <br>TYPE PK | <br>TYPE PKG | <br>TYPE PKS | <br>TYPE PKC |
| **NON-JACKETED CONTINUOUS ARMORED CABLE** | <br>TYPE PK | <br>TYPE CPKG | <br>TYPE CPKS | <br>TYPE CPKC |
| **INTERLOCKED & CONTINUOUS JACKETED ARMORED CABLE** | <br>TYPE PK | <br>TYPE PG | <br>TYPE PG | <br>TYPE SPKC |

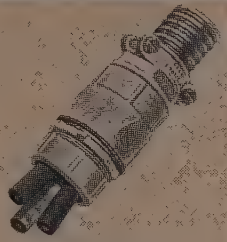
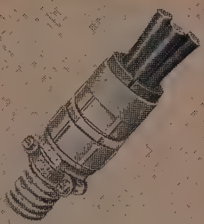
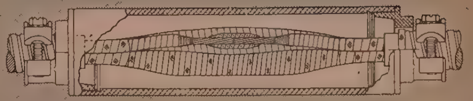
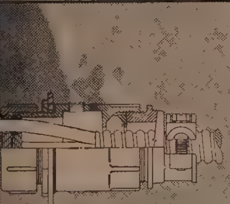
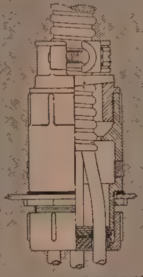
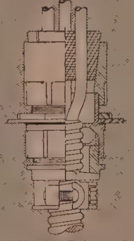
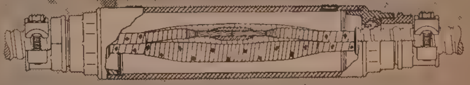
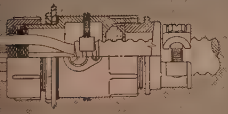
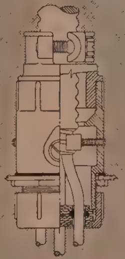
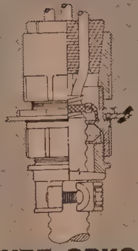
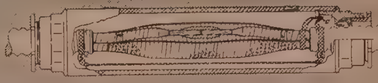
*Send today for a complete catalog on OZ's Armored Cable Fittings*

# 'FITTING" ANSWER

## ABLE* TERMINATING AND SPLICING PROBLEMS

's complete line of armored cable fittings means that you can specify "off-the-shelf" answers to
nost all your problems.

few of the more popular terminators and fittings are pictured. It illustrates the broad selection
mediately available to you for use on any type armored cable.

| VATERTIGHT<br>orizontal — with<br>ompound Chamber. | WATERTIGHT<br>Inverted — with<br>Compound Chamber. | VERTICAL SUPPORT TYPE | SPLICING FITTINGS |
|---|---|---|---|
| **TYPE PKH** |  **TYPE PKT** |  **TYPE PKR** | **PKJV-1**  Non-Watertight: 600V Varnished Cambric Insulated Interlocked Armored Cable. |
|  **TYPE CPKH** |  **TYPE CPKT** |  **TYPE CPKSR**<br>**(WATERTIGHT)** | **CPKJV-5**  Watertight: 5KV (Max.) Varnished Cambric Insulated Continuous Armored Cable. |
|  **TYPE SPKH** |  **TYPE SPKT** |  **TYPE SPKSR**<br>**(WATERTIGHT)** | **SPKJV-15**  Watertight: 15KV Shielded Varnished Cambric Insulated Interlocked or Continuous Armored Cable. |

**O.Z. ELECTRICAL MANUFACTURING CO., INC.**

262 BOND STREET • BROOKLYN 17, N. Y.

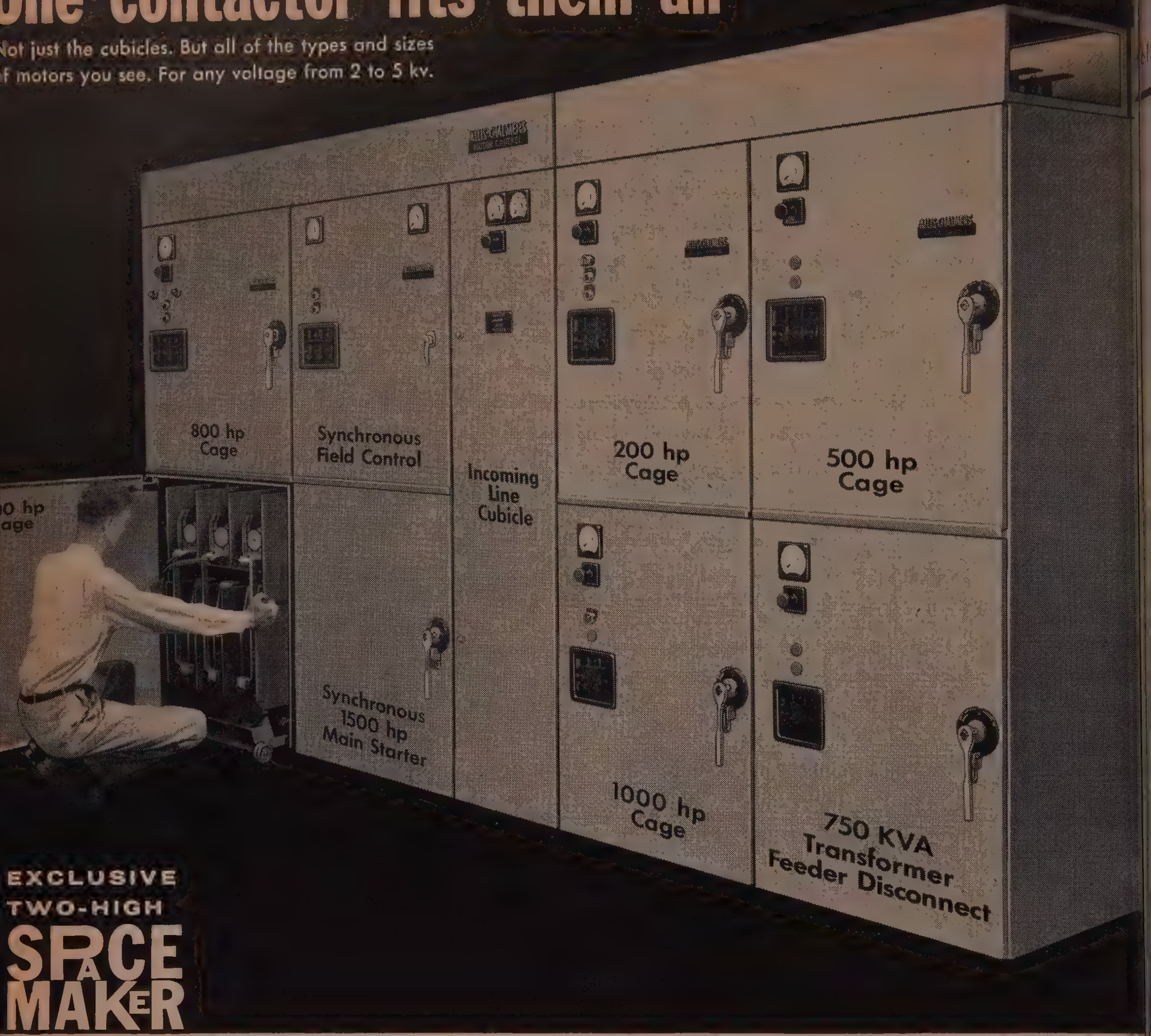
- CAST BOXES
- CABLE TERMINATORS
- POWER CONNECTORS
- SOLDERLESS CONNECTORS
- GROUNDING DEVICES
- CONDUIT FITTINGS
- ARMOR CABLE FITTINGS

Sales Office & Warehouse: 406 So. Cicero Ave., Chicago 44, Ill. • ES 9-0326
Office & Warehouse: 665 So. Van Ness Ave., San Francisco 2, Calif. • MA 1-4075

Copyright 1962, O.Z. Electrical Manufacturing Co., Inc.

# One contactor fits them all

Not just the cubicles. But all of the types and sizes
f motors you see. For any voltage from 2 to 5 kv.


800 hp Cage
Synchronous Field Control
Incoming Line Cubicle
200 hp Cage
500 hp Cage
0 hp age
Synchronous 1500 hp Main Starter
1000 hp Cage
750 KVA Transformer Feeder Disconnect
ALLIS-CHALMERS

EXCLUSIVE
TWO-HIGH
SPACE
MAKER

**Full-Rated,**
**HIGH-VOLTAGE**
**CONTROL**

# Cut your control costs five ways

See how this design in depth *reduces taxes*, inventory, lost production, capital investment, and installation expense.

**Complete interchangeability:** One contactor handles all motors—cage, wound rotor or synchronous—up to 1500 hp, 2300 volts . . . or 2500 hp, 4160 volts.

**Maximum cable accessibility:** Plenty of space for incoming and outgoing cables and conduit.

**Complete safety:** A 60-kv BIL design standard provides maximum protection to personnel and system.

**Simple maintenance:** One set of spare parts fits all the contactors in the line-up. Complete draw-out construction speeds inspection.

**Save floor space:** The 14-ft line-up shown above illustrates how compact and flexible two-high design can be.

This compact design with all these premium advantages *at no price premium* will meet all your special needs. Call your nearby A-C representative, or write **Allis-Chalmers,** Box 512, Milwaukee 1, Wisconsin.

**ALLIS-CHALMERS**

A-1651

1ST YEAR • AUGUST 1962

ELECTRICAL
CONSTRUCTION
AND MAINTENANCE

# Dynamic Floodlighting

**The installation of "Lumadrama"** at Independence Hall in Philadelphia last month marks the introduction in this country of a novel art form. It suggests that we may be on the threshold of an entirely new and much more sophisticated approach to the floodlighting of historical monuments and prominent buildings. It will be welcome. Fresh and original concepts in spectacular outdoor lighting have been surprisingly rare during a generation or more of nearly explosive developments in the art and science of illumination.

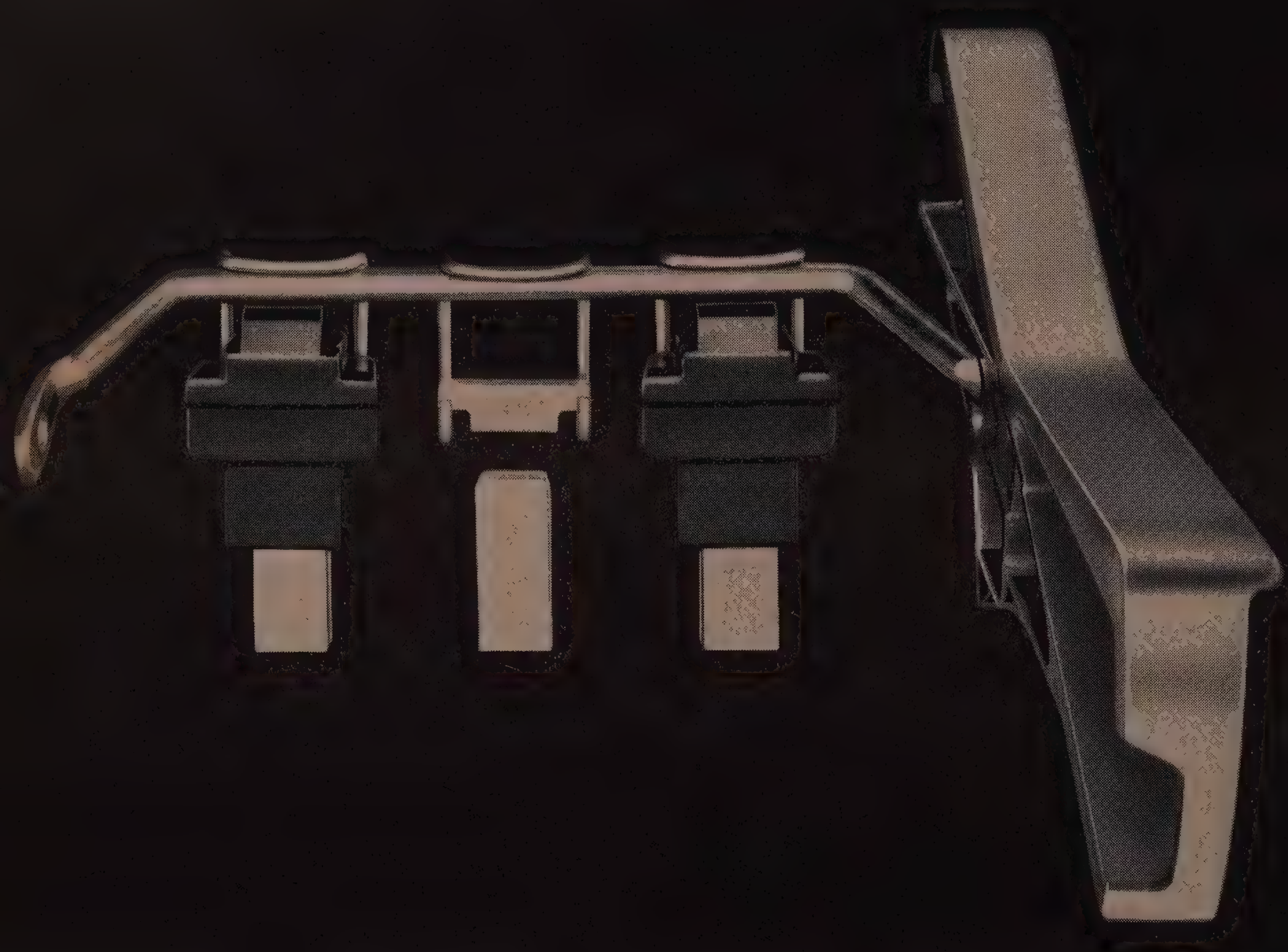
**Lumadrama is primarily theatrical.** A program of voices and music dealing with historical events are recorded on multichannel tape. The same tape also operates an elaborate sequence of synchronized lighting effects of great variety and beauty. The arts of dynamic theater lighting are applied to the illumination of a national shrine and the dramatic results should excite the creative imagination of lighting engineers and specialists everywhere.

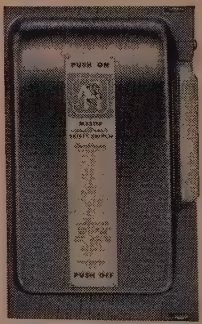
**Typical building facade lighting** today is usually provided from fixed lighting sources giving uniform color and intensity. The Philadelphia installation dramatizes and exploits elements of lighting application, notably mobility, color, contrast and detailing, which have been singularly lacking in conventional building floodlighting practice.

**Dynamic spectacular outdoor lighting** is not new to the United States but its application to structures in recent times is uncommon. On the other hand fixed or static floodlighting of buildings is gaining rapidly in popularity. One of the most remarkable and attractive applications is the floodlighting of modern low industrial buildings in landscaped grounds along our highways. Even these modest installations could be brought to life with programmed dynamic techniques.

**Once lighting specialists accept** the challenge of dynamic floodlighting the prospects are limitless. There is no end to the variety of effects that can be achieved. Whether the subject is an historic courthouse or a Main Street bank building, each installation can have its own vivid individuality. As a starter we recommend a visit to Philadelphia's Lumadrama to see how dynamic lighting can make a building come alive.

Wm. T. Stuart





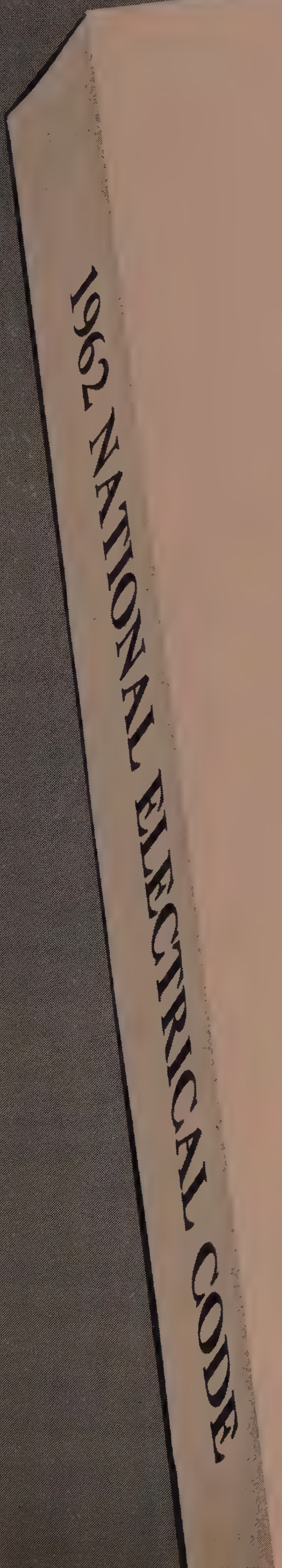
**SWITCHING SAFETY!** . . . SAFE, POSITIVE, FOOLPROOF OPERATION IS ACCOMPLISHED EVERY TIME FOR A LIFETIME BY A DIRECT CONNECTION BETWEEN THE OPERATING HANDLE AND THE SWITCHING CONTACTS. BULLDOG VACU-BREAK® SWITCHES ARE YOUR BEST BUY. CONTACT YOUR I-T-E DISTRIBUTOR OR LOCAL I-T-E SALES OFFICE TODAY.

Write for your copy of "The Story Behind the Ad"

**I-T-E CIRCUIT BREAKER COMPANY**
**BULLDOG ELECTRIC PRODUCTS DIVISION**
BOX 177 • DETROIT 32, MICHIGAN

In Canada: 80 Clayson Rd., Toronto, Weston, Ontario

ELECTRICAL
CONSTRUCTION
AND MAINTENANCE



# *HIGHLIGHTS OF THE*
# 1962 National Electrical Code

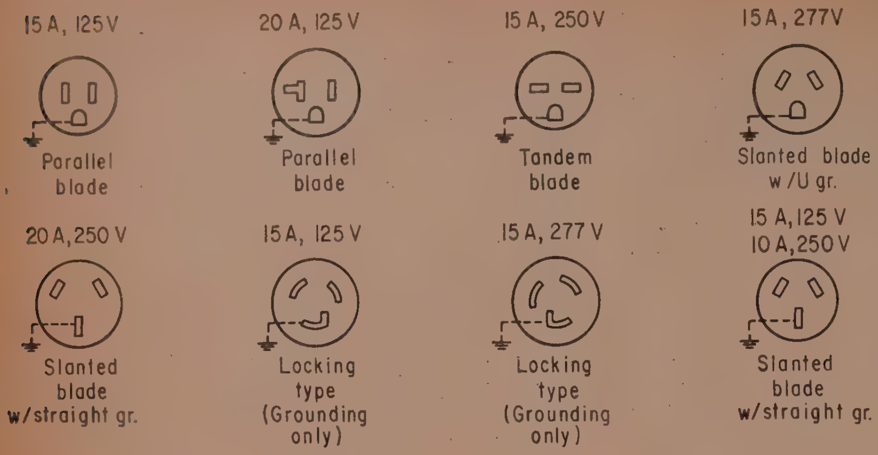
A review of the major code revisions that should influence new design and installation techniques for wiring, devices and utilization equipment.

**By J. H. Watt**

THE 1962 NEC has taken giant strides to keep abreast with technological advances in the electrical industry. Scheduled to be issued this September, the forthcoming code contains nearly 300 revised or new rules, in addition to four new code articles and several completely revised articles. The four new code articles prescribe regulations for rigid non-metallic conduit, aluminum sheathed cable, continuous rigid cable supports, and swimming pools. Other requirements cover such innovations as: only grounding-type receptacles permitted on 15- or 20-amp circuits; increased uses of 480Y/277-volt lighting; recognition of the principle of double insulation in lieu of grounding for certain portable equipment in residential occupancies; raising the voltage ratings of dry-type or askarel-insulated transformers (inside buildings) from 15 kv to 35 kv without the use of a vault; and recognition of new types of metal-clad cable (formerly termed armored cable).

Because of the vast number of

TYPICAL 15-AND 20-AMP GROUNDING-TYPE RECEPTACLES



Receptacles installed on 15-and 20-amp. br. circuits shall be of the grounding type. P. 210-21 (b)

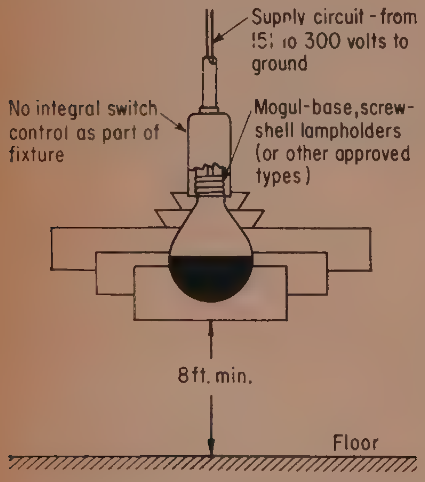
code revisions involved, it is possible to include in this article only those changes which seem to have the greatest impact on the design and installation of wiring and equipment. These changes are described under the code article in which they appear.

### *Article 100 Definitions*

A number of new and revised definitions are included to clarify terms used in various parts of the code.

New definitions include those for: Fixed Appliance, Stationary Appliance, Attachment Plug (Plug Cap) (Cap), Receptacle (Convenience Outlet) and Utilization Equipment.

Revised definitions include those for: Appliance, Portable Appliance, Circuit Breaker, Explosion-Proof Apparatus, Externally Operable, Isolated, Voltage, and Weatherproof.


Supply circuit - from 151 to 300 volts to ground
No integral switch control as part of fixture
Mogul-base, screw-shell lampholders (or other approved types)
8 ft. min.
Floor

P.210-6(a).Exception No.1 permits this arrangement in industrial plants or in stores where competent maintenance and supervision exist.

The new definition for Appliance states that it is "utilization equipment, generally other than industrial, normally built in standardized sizes and types, which is installed or connected as a unit to perform one or more functions such as clothes washing, air conditioning, food mixing, deep frying, etc."

A Fixed Appliance is "an appliance which is fastened or otherwise secured at a specific location." Typical examples would be waste disposers, wall-mounted ovens and counter-mounted cooking units.

A portable appliance is "an appliance which is actually moved or can be easily moved from one place to another in normal use." Some examples would be toasters, waffle irons, portable space heaters, and hand irons or similar small hand-held, cord-equipped appliances.

A stationary appliance is "an appliance which is not easily moved from one place to another in normal use." Typical examples are free-standing ranges and clothes dryers.

### *Article 210 Branch Circuits*

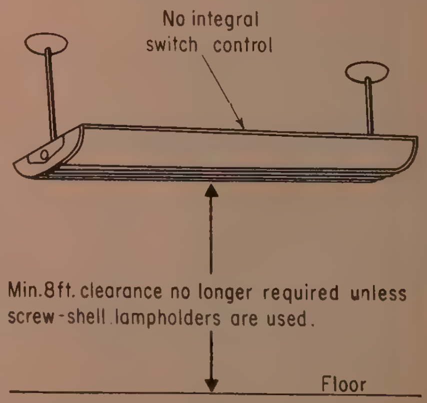
Paragraph 210-6 (a). Exception No. 1. Lighting fixtures equipped with mogul-base screw-shell lampholders (mounted not less than 8 ft from the floor and without integral switch control in the fixture) may now be used on circuits rated at 151 to 300 volts to ground—"in stores where the conditions of maintenance and supervision assure that only competent individuals will service the lighting fixtures." In such occupancies 480Y/277-volt circuits can be used to supply a combination of continuous-row fluorescent fixtures and mogul-base lampholders for incandescent lamps (added for "punch" lighting). Previously, this code rule applied only to industrial establishments.

Paragraph 210-6 (a). Exception No. 2. For circuits rated between 151 to 300 volts to ground, the previous rule that required permanently installed electric discharge fixtures to be installed at least 8 ft from the floor no longer applies unless the lampholders are of the screw-shell type. Because of this revision, further use of 480Y/277-volt circuits for fluorescent lighting can be expected.

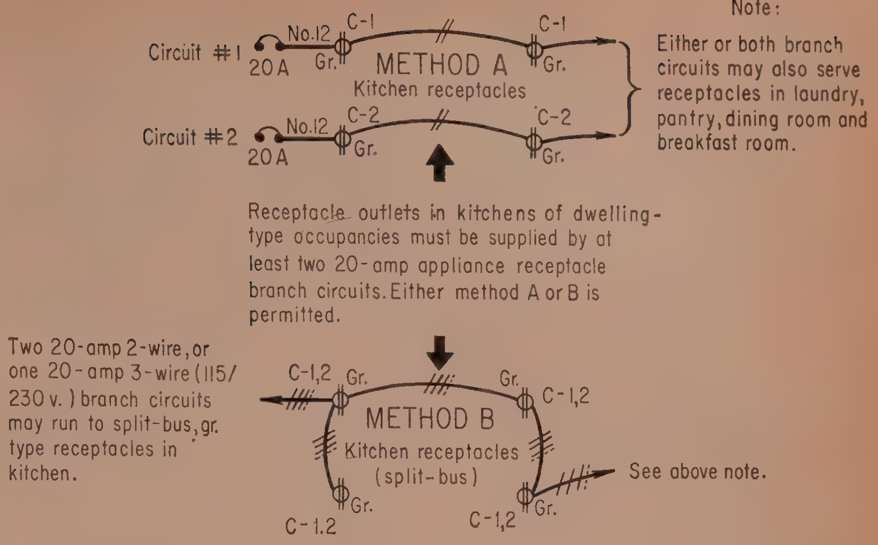
Section 210-7. An exception has been added to permit the installation of a separate grounding wire from a grounded cold water pipe to the grounding contacts of grounding-type receptacles added to existing branch circuits not having a grounding conductor. But on new work, non-metallic type cables supplying grounding-type receptacles must contain a grounding conductor. The metal armor of Type AC metal-clad cable, the sheath of aluminum sheathed cable, or a metallic raceway is acceptable as a grounding conductor, except in the case of swimming pool equipment.

Paragraph 210-21 (b). Receptacles installed on 15- and 20-amp branch circuits shall be of the grounding type. However, receptacles installed on 30- or 50-amp branch circuits need not be of the grounding types because other code rules permit the grounded neutral conductor to serve as an equipment ground for ranges or clothes dryers served by 120/240-volt, 3-wire branch circuits. A major feature of

P.210-6(a). Exception No.2 applies to branch circuits (rated from 151 to 300 volts to ground) that supply ballasts for electric discharge lamps in permanently installed fixtures.


No integral switch control
Min. 8 ft. clearance no longer required unless screw-shell lampholders are used.
Floor

P. 220-3 (b)


Circuit #1
No.12
20A
C-1
Gr.
METHOD A
Kitchen receptacles
C-1
Gr.
Circuit #2
No.12
20A
C-2
Gr.
C-2
Gr.
Note:
Either or both branch circuits may also serve receptacles in laundry, pantry, dining room and breakfast room.
Two 20-amp 2-wire, or one 20-amp 3-wire (115/230 v.) branch circuits may run to split-bus, gr. type receptacles in kitchen.
C-1,2
Gr.
Gr.
C-1,2
METHOD B
Kitchen receptacles
(split-bus)
Gr.
C-1,2
Gr.
C-1,2
See above note.

Receptacle outlets in kitchens of dwelling-type occupancies must be supplied by at least two 20-amp appliance receptacle branch circuits. Either method A or B is permitted.

the grounding-type receptacle is that it will handle grounding or nongrounding type portable equipment. At the same time, the new code rule stresses that the installation of grounding-type receptacles shall not be used as a requirement that *all* portable equipment be of the grounding type. Section 250-45 specifically covers portable equipment which is required to be grounded. The installation of grounding-type receptacles must conform to Sections 210-7 and 250-74.

Paragraph 210-22 (b). All references to grounding-type receptacles have been deleted, and the first paragraph is the same as in the 1959 text except the word "usable" has been deleted in two places. With the new wording, the location of receptacles in dwelling-type occupancies should be easier to determine because the term, **usable** wall space, has been a source of controversy according to code authorities. By deleting the word "usable" a few more receptacles may be required in each new dwelling-type occupancy.

### *Article 220 Branch-Circuit and Feeder Calculations*

Paragraph 220-3 (b) now requires two 20-amp appliance receptacle branch circuits in the kitchen of a dwelling-type occupancy. However, either or both of these circuits can supply receptacles in a dining room, laundry, pantry or breakfast-room.

### *Article 230 Services*

Section 230-26. A new paragraph recognizes the use of a mast-type service riser to support the service drop to low-roof buildings. Proper construction and support of the mast is required. Complete details for mast services are usually covered by local utilities or local inspection authorities.

Section 230-44 adds wireways to the list of approved wiring methods for service-entrance conductors.

Paragraph 230-101 (h) now permits service-entrance conductors on circuits over 15 kv to enter metal-clad switchgear in lieu of a transformer vault.

### *Article 240 Overcurrent Protection*

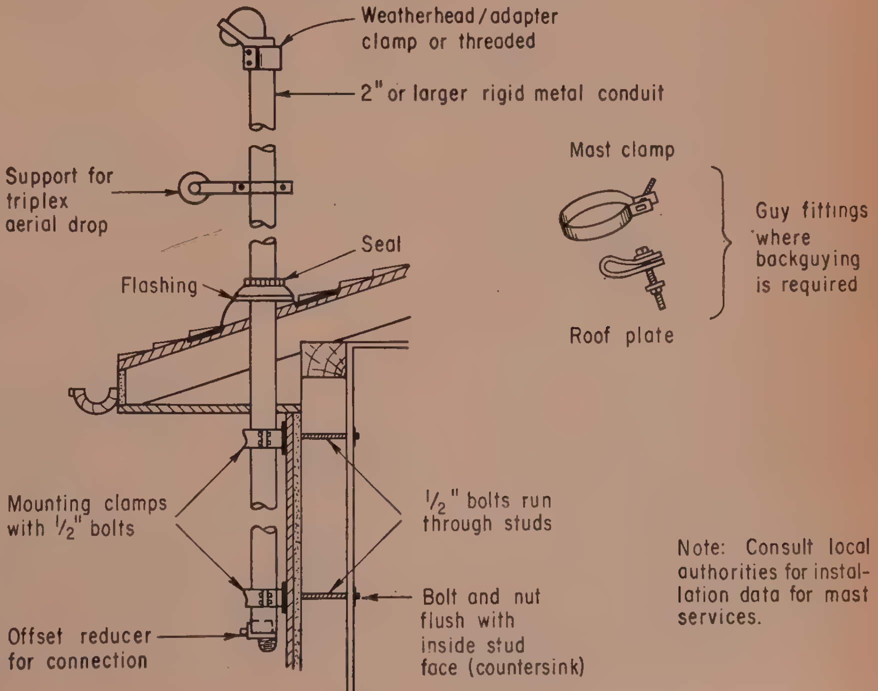
Paragraphs 240-5, Exception No. 1; 240-6 (a); and 240-7 (a) permit the next larger size or rating of overcurrent device, when conductor carrying capacities do not correspond to standard overcurrent device ratings, but only where the rating is 800 amps or less. This affords better protection for conductors in the higher ampere ratings.

Paragraph 240-22 (a) changes the classification of Type S fuses and fuseholders into three groups—0 to 15 amps, 16 to 20 amps, and 21 to 30 amps. Ratings in these classifications have been available for a number of years, but the code had previously called for only two classifications.

Paragraph 240-23 (a) (2). Additional classifications for cartridge fuses and fuseholders rated over 600 amps are: (1) 601 to 800 amps; (2) 801 to 1200 amps; (3) 4001 to 5000 amps; and (4) 5001 to 6000 amps. The new classifications will assure better protection for larger conductors.

New Section 240-30 recognizes supplementary overcurrent protection for appliances, motors, or other utilization equipment. Such protection is in addition to required branch-circuit protection. The major feature of this new code rule is

S. 230-26 REQUIRES RIGID CONSTRUCTION OF MAST-TYPE SERVICES


Weatherhead/adapter clamp or threaded
2" or larger rigid metal conduit
Support for triplex aerial drop
Mast clamp
Guy fittings where backguying is required
Roof plate
Seal
Flashing
Mounting clamps with 1/2" bolts
1/2" bolts run through studs
Offset reducer for connection
Bolt and nut flush with inside stud face (countersink)

Note: Consult local authorities for installation data for mast services.

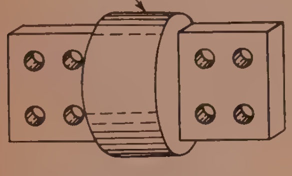
Type S fuses and fuseholders

P. 240-22(a)

New classifications:

0 to 15 amps
16 to 20 amps
21 to 30 amps

600-volt cartridge fuse over 600 amps



P. 240-23(a)(2)
New classifications for
fuses and fuseholders

601 – 800A
801 – 1200A
1201 – 1600A
1601 – 2000A
2001 – 3000A
3001 – 4000A
4001 – 5000A
5001 – 6000A

that supplementary overcurrent protective devices need not be readily accessible. A common application of supplementary overcurrent protective devices would be where small fuses are inserted in line conductors supplying fluorescent lamp ballasts and are located within the fixture. But such fuses cannot be used as a substitute for branch-circuit overcurrent devices.

### *Article 250 Grounding*

Section 250-23. New paragraph (a) is the same as Section 250-23 in the 1959 text. New paragraph (b) is a significant revision, which reads: "**Where** the secondary system is grounded at **any** point, the grounded conductor shall be run to each individual service. This conductor shall not be smaller than the required grounding conductor specified in Table 250-94 (a)." This new rule will apply even though the grounded conductor will not be used in the circuits supplied—because the grounded conductor, properly grounded at an individual service, provides a low-impedance grounding path to supply transformers and will permit the proper function of overcurrent devices if a line-to-ground fault occurs in an ungrounded conductor. However, Paragraph 250-23 (b) will not become effective until January 1, 1964.

Paragraph 250-45 (c) specifies the type of portable equipment required to be grounded when used in residential occupancies. No new equipment has been added, but chuck capacities no longer determine when electric drills should be grounded. On the other hand, the new exception to this paragraph could be a milestone in the prevention of electric shock for users of portable equipment. This exception recognizes the principle of double-insulation in the construction of the residential portable equipment listed in Paragraph 250-45 (c). Where such equipment incorporates this principle, grounding will not be required. According to UL, a number of appliance and tool manufacturers are interested in submitting equipment of this type for UL listing. Many authorities feel that the double-insulation features will be far superior to those depending on the integrity of a grounding conductor.

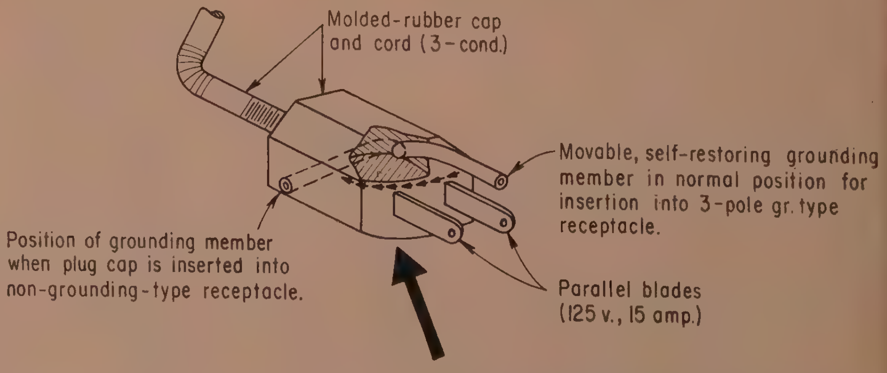
Paragraphs 250-59 (a) and (b). Previously, these code rules have required a grounding-type attachment plug containing one fixed contact member for the purpose of grounding portable equipment required to be grounded. An exception, which recognizes a new concept in grounding-type attachment plugs, now appears after paragraphs (a) and (b). This new grounding-type cap features a movable, self-restoring grounding contact member. As a result, the plug cap may be inserted into either a grounding-type or non-grounding-type receptacle. The permitted use of this special plug cap is limited to hand-held tools or hand-held appliances.

New Section 250-74 pertains to bonding at grounding-type receptacles where they are attached to grounded boxes. Usually a metal outlet box is grounded through connection to a grounded metallic cable or raceway, or by a grounding conductor of a non-metallic cable. Since the mounting strap and ground slot of a grounding-type receptacle are integrally bonded, the two metal attachment screws, securing the receptacle mounting strap to a properly grounded metal box, will afford adequate grounding conductivity to the receptacle ground slot if the screws are tight. However, in the case of flush-type boxes where the finish surface is soft material, such as plasterboard, a bonding jumper between the box and the ground-slot terminal on the receptacle may be necessary to insure a proper grounding connection. But in **any** event, it would be advisable to bond the receptacle ground-slot terminal to the metal box because of the importance of a reliable grounding circuit.

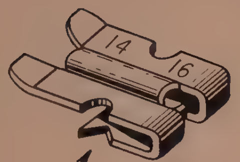
New Section 250-114. In effect, this code rule states that where a grounding conductor enters a metal outlet box it must be connected to the box by means of a grounding screw (used for no other purpose) or by an approved grounding device (such as the popular spring-steel grounding clip). Where several grounding conductors enter the same box they must be properly joined together, and a final connection made to the grounding screw or grounding clip. In non-metallic boxes, grounding conductors must be attached to any metal fitting or wiring device required to be grounded.

### *Article 310 Conductors For General Wiring*

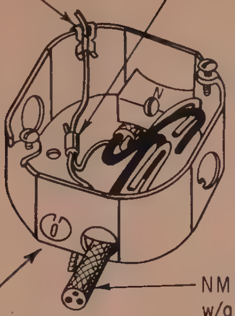
Table 310-2 (a). The new Type THWN wire is included in this table. This wire has a moisture and heat-resistant thermoplastic insulation with an outer nylon braid. It


Molded-rubber cap
and cord (3-cond.)
Movable, self-restoring grounding member in normal position for insertion into 3-pole gr. type receptacle.
Position of grounding member when plug cap is inserted into non-grounding-type receptacle.
Parallel blades (125 v., 15 amp.)

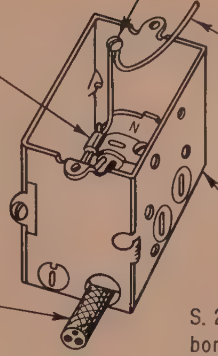
This type of receptacle cap now permitted for hand-held tools or hand-held appliances. P. 250-59 (a) and (b)



Approved grounding clip will satisfy bonding connections specified in S. 250-74 and S. 250-114


Approved grounding clip bonds grounding wire to box
Grounding wires spliced together w/approved connectors
NM cables w/gr. wire

S. 250-114. Typical method of grounding metal outlet boxes


Grounding wire bonded to box w/screw used solely for connecting such wire
Grounding conductor connects to gr. terminal of 3-pole gr. type receptacle
NM cables w/gr. wire

S. 250-74. Typical method of bonding at flush-type metal boxes used to support grounding-type recept

is approved for use in dry or wet locations at a maximum operating temperature of 75°C. Made in sizes up to 500 MCM the THWN conductors have smaller over-all diameters than corresponding T or TW sizes, and would seem ideally suited for rewiring existing raceways or other uses where small-diameter wires are necessary.

### *Article 318 (New) Continuous Rigid Cable Supports*

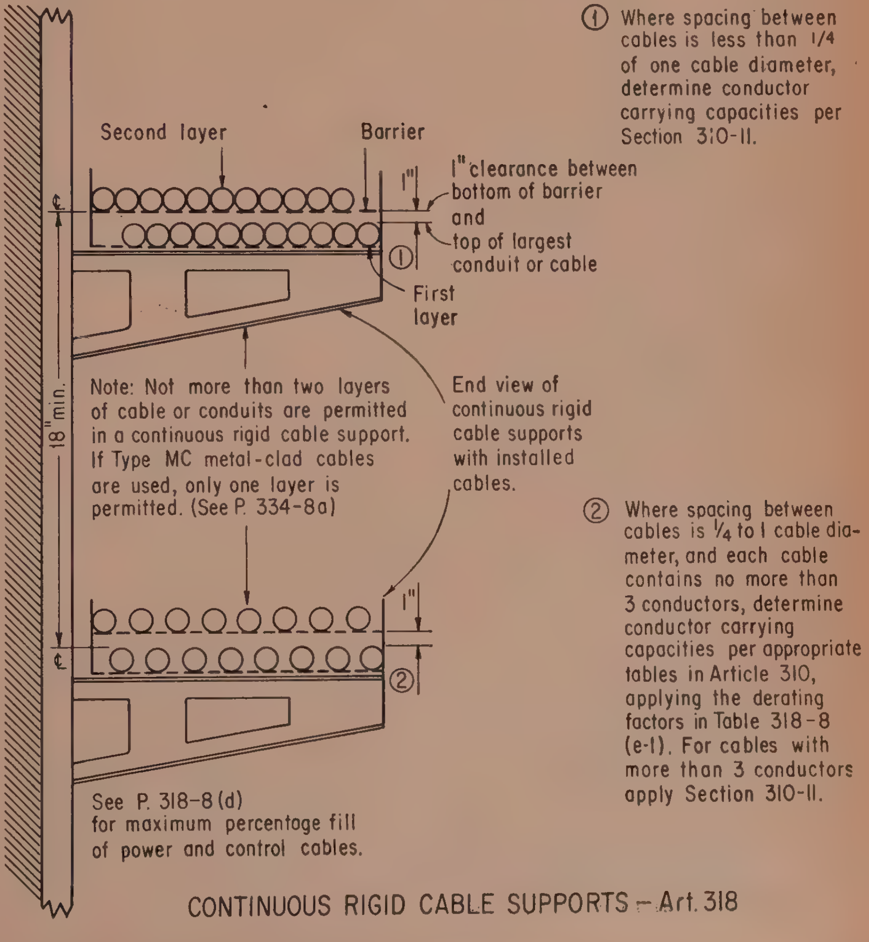
This new code article clarifies the status of so-called "ventilated cable trays or cable troughs." Such material now has code recognition only as a means of support for approved general wiring methods such as MI cable, metal-clad cable, non-metallic sheathed cable, SE cable, UF cable, and conduits with contained conductors. However, Section 318-8 does permit the development of factory-assembled, multiple-conductor control or signal circuit and power cables specially approved for use in continuous rigid cable supports installed in industrial or commercial occupancies. Indications are that these cables will be heavy-duty nonmetallic types, and should be available in the near future.

Other requirements for continuous rigid cable supports state that: (1) they cannot contain standard building wires such as Type R, T, etc.; (2) they may be used for exposed work in wet or dry locations only in areas of fire-resistive or non-combustible construction or other construction acceptable to the authority enforcing the code; (3) they are not permitted in hoistways, hazardous locations, and where subject to severe physical damage; (4) they are not recognized as an equipment grounding conductor or as a grounded (e.g. neutral) conductor; (5) they shall contain not more than two layers of cable or raceway, and where a second layer is installed, a 1-in. air space is required above the first layer (Type MC metal-clad cable is limited to one layer per Paragraph 334-8a); (6) the vertical spacing between continuous rigid cable supports shall be at least 18 in. center to center; and (7) splices and taps are permitted only in junction boxes or fittings approved for the purpose.

Section 318-8 describes the maximum percentage fill of cables in rigid cable supports and how to determine the fill. Derating factors are also included.

### *Article 331 (New) Aluminum Sheathed Cable—Type ALS*

This new wiring method is a factory-assembled cable consisting of one or more insulated conductors enclosed in an impervious, continuous, closely fitting, seamless aluminum tube. While new in this country, aluminum sheathed cable has been widely used in Great Britain and Canada.


Second layer
Barrier
1"
1" clearance between bottom of barrier and top of largest conduit or cable
①
First layer
End view of continuous rigid cable supports with installed cables.
18" min.
℄
℄
1"
②

① Where spacing between cables is less than 1/4 of one cable diameter, determine conductor carrying capacities per Section 310-11.

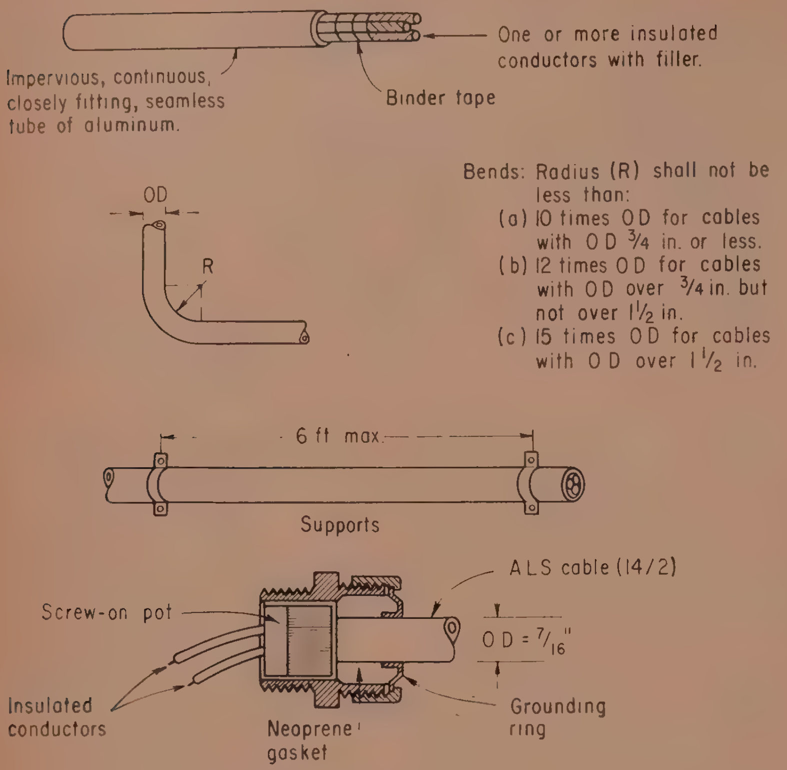
Note: Not more than two layers of cable or conduits are permitted in a continuous rigid cable support. If Type MC metal-clad cables are used, only one layer is permitted. (See P. 334-8a)

② Where spacing between cables is ¼ to 1 cable diameter, and each cable contains no more than 3 conductors, determine conductor carrying capacities per appropriate tables in Article 310, applying the derating factors in Table 318-8 (e-1). For cables with more than 3 conductors apply Section 310-11.

See P. 318-8 (d) for maximum percentage fill of power and control cables.

CONTINUOUS RIGID CABLE SUPPORTS — Art. 318

ALUMINUM SHEATHED CABLE
Art. 331



One or more insulated conductors with filler.
Impervious, continuous, closely fitting, seamless tube of aluminum.
Binder tape
OD
R
Bends: Radius (R) shall not be less than:
(a) 10 times OD for cables with OD 3/4 in. or less.
(b) 12 times OD for cables with OD over 3/4 in. but not over 1 1/2 in.
(c) 15 times OD for cables with OD over 1 1/2 in.
6 ft max.
Supports
ALS cable (14/2)
Screw-on pot
OD = 7/16"
Insulated conductors
Neoprene gasket
Grounding ring

Typical cast aluminum connector

Major requirements for Type ALS cable are: (1) it may be used in both exposed and concealed work, in dry or wet locations (with certain precautions where the cable is exposed to destructive corrosive conditions); (2) it shall be secured at intervals not exceeding 6 ft, except where the cable is fished; (3) the radius of the curve on the inner edge of any field bend shall be not less than 10, 12 or 15 times the external diameter of the cable sheath, depending on the size of the cable; and (4) fittings approved for the purpose shall be used to connect the cable to boxes or equipment.

By reference to other code articles, Type ALS cable is not recognized for use in hazardous locations, for services, or for direct burial in earth.

## Article 334 Metal-Clad Cable

This entire article, previously titled "Armored Cable," has been completely revised. Metal-clad cable consists of two classes—Type MC and Type AC.

In the Type MC series, the outer sheath is an interlocking metal tape or an impervious, closely fitting corrugated metal tube. Type MC cables will contain copper conductors No. 4 and larger or aluminum conductors No. 2 and larger; and the outer metal covering may be steel, aluminum, bronze or similar material. In the past, cables with metallic sheaths consisting of materials other than steel were not recognized by the NEC or UL. Therefore, the recognition of Type MC cable is another important industry advancement. At the same time, it does not appear that the code will recognize the metallic sheath of Type MC cables as a suitable equipment ground. And if this assumption is correct, such cables will include a grounding wire.

Type AC cable will include assemblies with No. 14 conductors and larger, and it is understood that the metallic sheath for Type AC cables will be limited to steel. Most of the previous rules in Article 334 of the 1959 NEC will continue to apply to Type AC cable.

Type MC cables are approved for both concealed and exposed work. Also, they may be used in wet locations if the metallic covering is impervious to moisture or the sheath, jacket or insulated conductors under the metallic covering are approved for the purpose.

Other new provisions include: (1) Type MC cable shall be secured at intervals not exceeding 6 ft (when attached to a surface) and within 2 ft from every box or fitting, except where cable is fished; (2) When Type MC cable is installed on grounded metal racks or continuous rigid cable supports, the cable shall be attached to the support at intervals not exceeding 10 ft horizontally and 2 ft vertically, and not more than one layer of such cables, separated from each other by a distance of one-quarter of a cable diameter, is permitted on a rack or other support member; and (3) The curve radius of the inner edge of any bend shall not be less than seven times the diameter of MC cable.

## Article 336 Non-Metallic Sheathed Cable

Section 336-2. Type NM or NMC non-metallic sheathed cable may now contain conductors up to No. 2. Previously the conductors were limited to No. 4. The No. 2 NM cables should find wide use in frame buildings where feeders of this size are required.

## Article 339 Underground Feeder and Branch-Circuit Cable

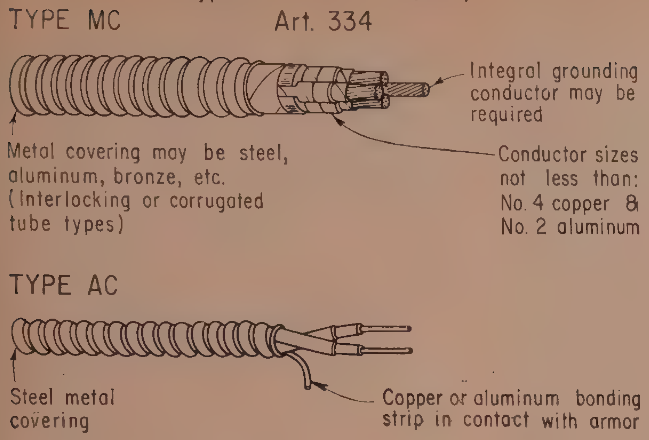
Paragraph 339-3 (c) has been revised to read: "A minimum depth of 18 in. shall be maintained for (UF) conductors and cables buried directly in the earth, when supplementary protection from mechanical injury, such as a covering board, concrete pad, raceway, etc., is not provided." This is the first time that the code has specified a minimum depth for unprotected UF cables, buried directly in earth.

## Article 347 (New) Rigid Non-Metallic Conduit

The provisions of this new article apply to types of rigid non-metallic conduits, which are resistant to moisture and chemical atmospheres.

For underground applications, the conduit must be acceptably resistant to moisture and corrosive agents and must have sufficient strength to withstand abuse, such as by impact and crushing, in handling and during installation. Where directly buried in earth, without concrete encasement, the conduit must also be capable of withstanding continued loading (such as backfill) which is likely to be encountered.

METAL-CLAD CABLES
(Type MC and AC series)
Art. 334



Integral grounding conductor may be required

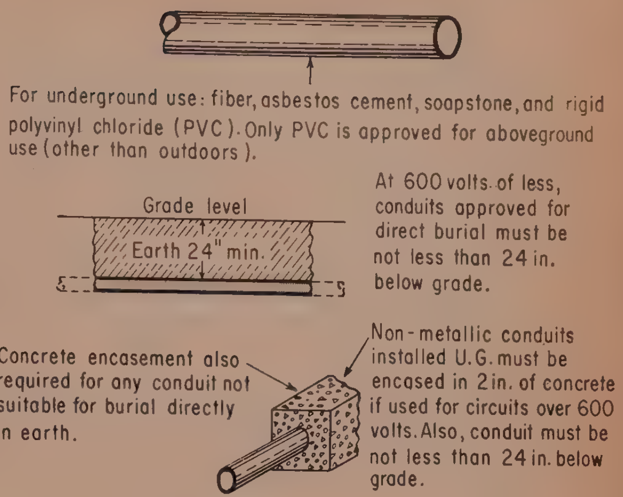
Metal covering may be steel, aluminum, bronze, etc. (Interlocking or corrugated tube types)

Conductor sizes not less than: No. 4 copper & No. 2 aluminum

Steel metal covering

Copper or aluminum bonding strip in contact with armor

RIGID NON-METALLIC CONDUIT
Art. 347



For underground use: fiber, asbestos cement, soapstone, and rigid polyvinyl chloride (PVC). Only PVC is approved for aboveground use (other than outdoors).

At 600 volts of less, conduits approved for direct burial must be not less than 24 in. below grade.

Concrete encasement also required for any conduit not suitable for burial directly in earth.

Non-metallic conduits installed U.G. must be encased in 2 in. of concrete if used for circuits over 600 volts. Also, conduit must be not less than 24 in. below grade.

Present UL listings of non-metallic conduits for underground work include conduits and fittings constructed of fiber, asbestos cement, soapstone and rigid polyvinyl chloride (PVC). Each manufacturer's listing states the particular types of conduits that require concrete encasement or those that can be buried directly in earth. Therefore, it would appear that these UL listings serve a useful purpose in determining the application of rigid non-metallic conduits in underground work as covered in Article 347. On the other hand, there is one noticeable exception to this procedure. New Paragraph 347-2 (a) states that rigid non-metallic conduits shall be not less than 24 in. below grade in the case of direct earth burial; but if the conduits contain conductors operating on circuits over 600 volts, the conduits also must be encased in 2 in. of concrete. And, at all voltages, conduits not approved for direct earth burial must be encased in concrete.

For aboveground installations (other than outdoors), rigid non-metallic conduit is required to be flame retardant, resistant to impact and crushing, resistant to distortion due to heat under conditions likely to be encountered in service, and resistant to the effects of low temperature. According to the footnote following Section 347-1, only rigid non-metallic, polyvinyl chloride conduit is recognized for aboveground installations, such as: in concrete walls and floors, locations subject to severe corrosive influences, and wet locations. In these instances, PVC conduit can be used as a wiring method in buildings. But indications are that some other types of non-metallic conduits may have a similar recognition in the future.

Prohibited uses of rigid non-metallic conduit are: (1) above ground *outdoors*; (2) in hazardous locations; (3) in the concealed spaces of combustible construction; (4) for the support of fixtures or other equipment; (5) where subject to physical damage; and (6) where the conduit contains conductors operating on circuits over 600 volts in other than underground installations.

Table 347-8 specifies the maximum spacing of conduit supports. And the number of conductors permitted in non-metallic conduits is the same as specified for metallic conduits, except that increased fills are not permitted where rewiring existing non-metallic conduits.

### *Article 370 Outlet, Switch and Junction Boxes and Fittings*

Table 370-6 (a-1) allows six No. 6 conductors in a $2\frac{1}{8}$-in. by $4\frac{11}{16}$-in. square box. Since No. 6 conductors are often used on multi-outlet 50-amp branch circuits, the inclusion of such conductors in this table should be helpful.

Table 370-6 (b) adds a figure of 5 cu. in. for a No. 6 conductor where computing combinations of conductors not shown in Table 370-6 (a-1).

### *Article 410 Lighting Fixtures*

Section 410-26. After Exception No. 2, a new sentence states that branch-circuit wires within 3 in. of a ballast shall be Type RHH or other types with a 90°C rating. This settles past controversies on what types of branch-circuit conductors are required where they are carried through continuous-row fluorescent fixtures. In such installations, the branch-circuit conductors will usually be within 3 in. of a ballast. While Type RHH conductors are specifically mentioned, other 90°C conductors, approved for branch-circuit wiring, would include Types SA and AVB. Also, Type AVA conductors, rated at 110°C, could be used.

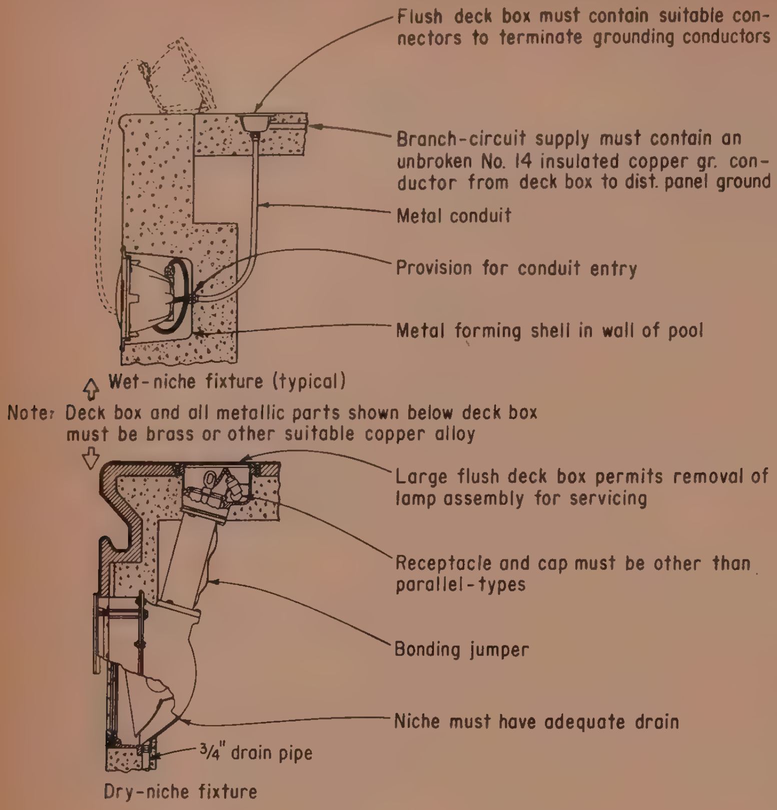
### *Article 450 Transformers and Vaults*

Sections 450-21 and 450-23. These sections previously required that indoor dry-type or askarel-insulated transformers, rated over 15,000 volts, must be installed in an approved transformer vault. The 15-kv limitation has been raised to 35 kv. With this significant revision, designers can now use primary distributions for metal-clad unit substations in buildings at more than double the previous maximum voltage.

### *Article 600 Electric Signs and Outline Lighting*

Section 600-6. This section has been revised to permit 20-amp branch circuits to supply incandescent lamps, fluorescent ballasts, and neon transformers, or combinations thereof when used for electric signs and outline lighting. A 30-amp branch circuit is permitted where only neon transformers are installed on the circuit.

NEW RULES FOR UNDERWATER SWIMMING POOL LIGHTING

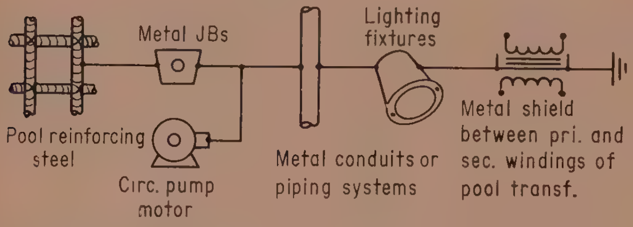

Flush deck box must contain suitable connectors to terminate grounding conductors
Branch-circuit supply must contain an unbroken No. 14 insulated copper gr. conductor from deck box to dist. panel ground
Metal conduit
Provision for conduit entry
Metal forming shell in wall of pool
Wet-niche fixture (typical)
Note: Deck box and all metallic parts shown below deck box must be brass or other suitable copper alloy
Large flush deck box permits removal of lamp assembly for servicing
Receptacle and cap must be other than parallel-types
Bonding jumper
Niche must have adequate drain
3/4" drain pipe
Dry-niche fixture

### *Article 680 (New) Swimming Pools*

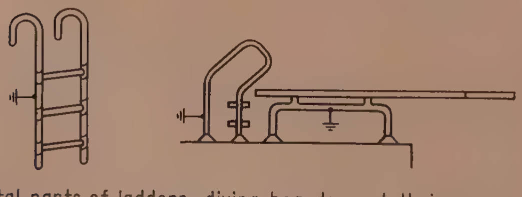
The provisions of this article apply to the construction and installation of electric wiring for equipment in or adjacent to swimming pools, to metallic appurtenances in or within 5 ft of the pool, and to auxiliary equipment such as pumps or filters.

Section 680-4 covers the installation of lighting fixtures installed below the pool surface. Major requirements are: (1) maximum voltage to fixtures cannot exceed 150 volts, with a recommendation that all circuits for such fixtures should be isolated (for example, a 120-volt 1:1 transformer would provide an ungrounded supply to fixtures); (2) if the circuit voltage exceeds 30 volts, an approved fail-safe ground detector device which automatically de-energizes the circuit, or an approved grid structure (a grounded metallic shield to confine electrical fields) is recommended; (3) transformers used to supply fixtures, together with the transformer enclosure, shall be approved for the purpose, and the transformers shall be of an isolating type with a grounded metal barrier between primary and secondary windings; (4) approved metal forming shells, with conduit hubs, are required for the mounting of all underwater fixtures; (5) the metal parts of fixtures, fixture housings, and the supply conduits from deck boxes to forming shells shall be brass or suitable copper alloy; (6) approved "dry-niche" fixtures may be installed outside the walls of the pool in closed recesses which are adequately drained and accessible for maintenance; and (7) no attachment plug receptacles shall be installed within 10 ft of the inside walls of the swimming pool, with a minor exception where special receptacles are provided in dry-niche fixtures.

SWIMMING POOL GROUNDING REQUIREMENTS


Metal JBs
Lighting fixtures
Pool reinforcing steel
Circ. pump motor
Metal conduits or piping systems
Metal shield between pri. and sec. windings of pool transf.

These metallic components must be bonded together and grounded to a common ground.



Metal parts of ladders, diving boards, and their supports, must be grounded.

Deck boxes less than 4 ft from the pool perimeter or less than 8 in. above the finished surface shall be constructed of brass or suitable copper alloy.

Transformers and enclosures shall be approved for wet locations or shall be located not less than 4 ft from the pool perimeter and not less than 12 in. above the ground, concrete surface and water level.

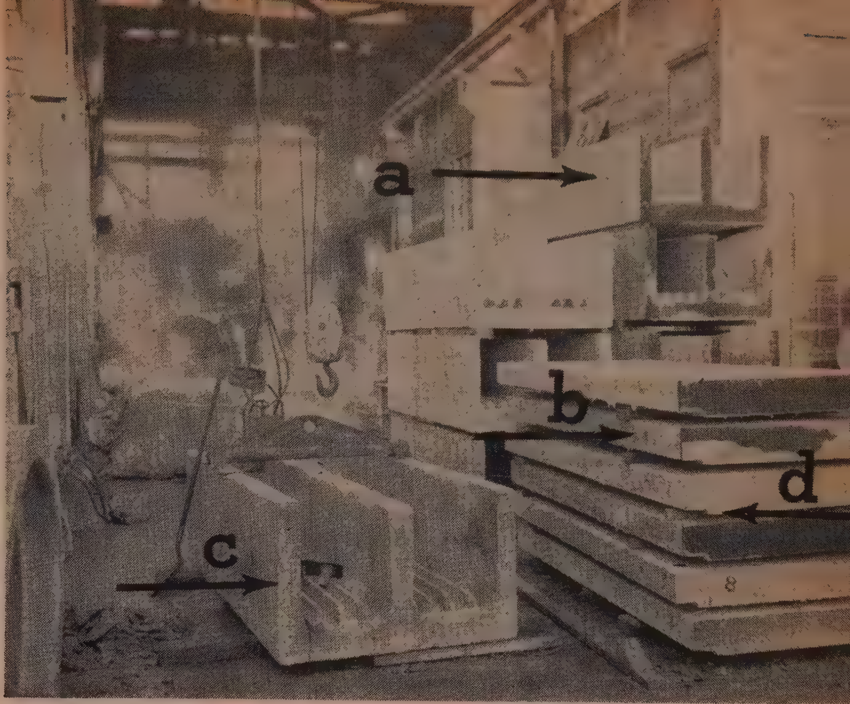
All metallic conduit, metallic piping systems, pool reinforcing steel, lighting fixtures, and the like, shall be bonded together and grounded to a common ground. In addition, the metal parts of ladders, diving boards, and their supports are required to be grounded. An unbroken No. 14, or larger, insulated copper conductor is required to be run from the deck box to the distribution panel ground.

This new code article is the result of extensive studies by a special technical subcommittee and several code-making panels.

### *Chapter 9 Tables*

New Table 4A gives the allowable percentage fills of conductors used for rewiring existing concealed metal conduits.

Table 5 has been revised to include the dimensions of THW conductors (No. 14 to No. 8) and THWN (No. 14 to 500 MCM).



**PRECAST SECTIONS** of sidewalk wiring troughs are reinforced concrete. Each 8-ft unit, consisting of grooved base and slab cover, weighs approximately 5 tons. Note holes A and B for insertion of lifting tongs; holes C for alignment dowels. Stepped shoulders D prevent lateral shifting of covers.

# Primaries Under Sidewalks

Unusual precast concrete troughs distribute primary power through Northwest community development. Buried conduits extend to customers' premises. Located parallel to streets and set flush with ground, continuous cover sections also serve as sidewalks. Prime contractor for entire primary installation was Industrial Electric, Seattle, Wash.

AN UNDERGROUND electrical distribution system of unique design is being installed in a community near Seattle, Wash. Wiring is laid in precast concrete troughs sunk in trenches. The trough covers form the sidewalks of the area. The novel installation provides the esthetic and maintenance advantages of a complete underground system while permitting ready and unlimited access to the system at any time by properly equipped and authorized utility crews.

Typical trough sections, made of reinforced concrete, measure 8-ft in length, 4-ft in width and 3-ft in depth, including a 7-in. thick cover. Weight of each cover is 3350 lbs; trough sections weigh approximately 3 tons each. Trough sections are partitioned lengthwise by a 4-in. wall down the center. Each half-section is grooved along the bottom to provide four separate troughs for holding single-conductor primary cables. In addition, metal plates, precast into side walls, are designed to accept brackets for the support of splices or additional cables. Cable space is ample to satisfy future power requirements in this mushrooming community development which is expected to reach a population of 350,000.

Trough cover slabs are constructed with stepped shoulders to prevent lateral shifting. Shoulders are keyed to the side walls of the trough sections to prevent longitudinal movement as well. Ends of abutting trough sections are fitted with premolded membranes. Mastic filler strips are placed between adjacent cover slabs. Trough sections are laid on a base of 4-in. gravel, tamped firm prior to installation. Special care was exercised in setting the troughs to assure exact sidewalk elevations.

At all low points in the trough and at least every 50 ft along level runs, 3-in. drain holes are provided. Expansion joints are spaced at intervals of 50 ft or less, depending upon local construction details.

Adherence to exact elevations is particularly important at street-crossing points, where trenches terminate. In such instances, terminal sections slope downward at the bottom, going deeper to permit alignment with 6-in. steel conduits which run 5 ft beneath roadways. The conduits connect with continuing troughs on the other side of the roadway.

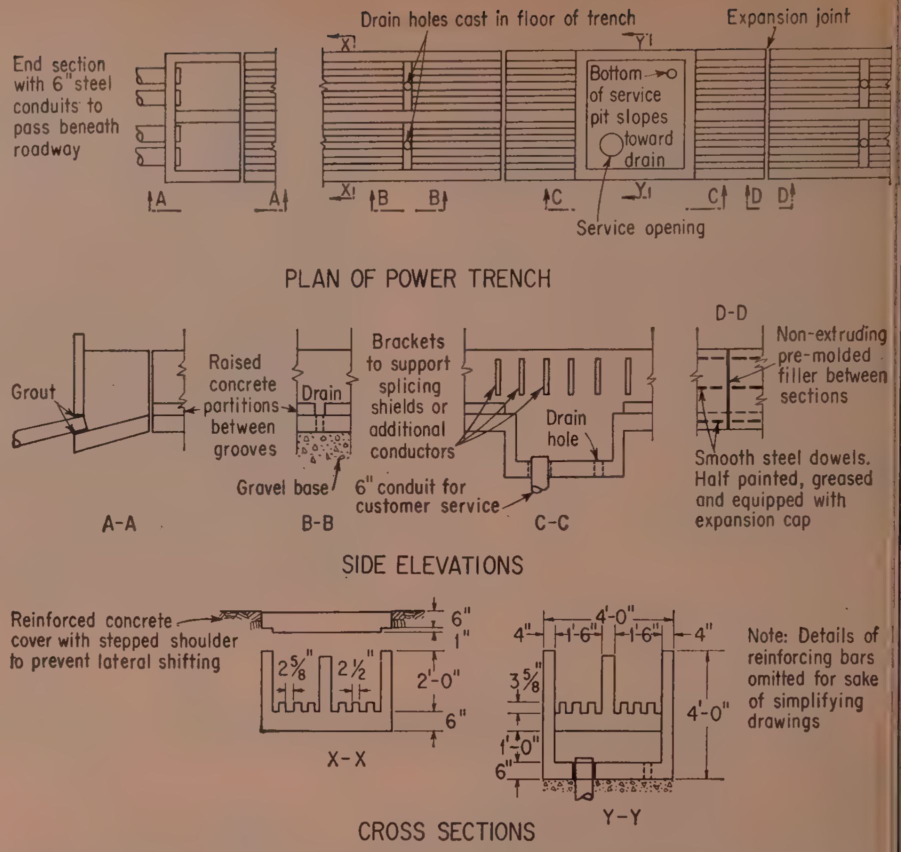
Special sections are inserted along the runs for customer-service connections. They consist of dropped bays, the floors of which are depressed 1½ ft lower than the trough floor. Six-in. distribution conduits are carried downward from the bay, then laterally to customer premises. Where service conduits pierce floors of dropped bays, ends are stubbed 1 in. above floor level, grouted in place and capped with insulating bushings. Each bay also is equipped with a ground rod and clamp from which a flexible braid conductor extends to each splicing shield located within the service cubicle.

As noted in an accompanying sketch, splice shields are T-shaped, with taps directed either downward or horizontally, depending upon whether the tap is to enter a customer's service conduit or connect laterally with an intersecting trench section. Rigid steel conduits are painted with bitumastic to inhibit corrosion. Concrete in precast trench sections has a 28-day compressive strength of 3000 lbs.

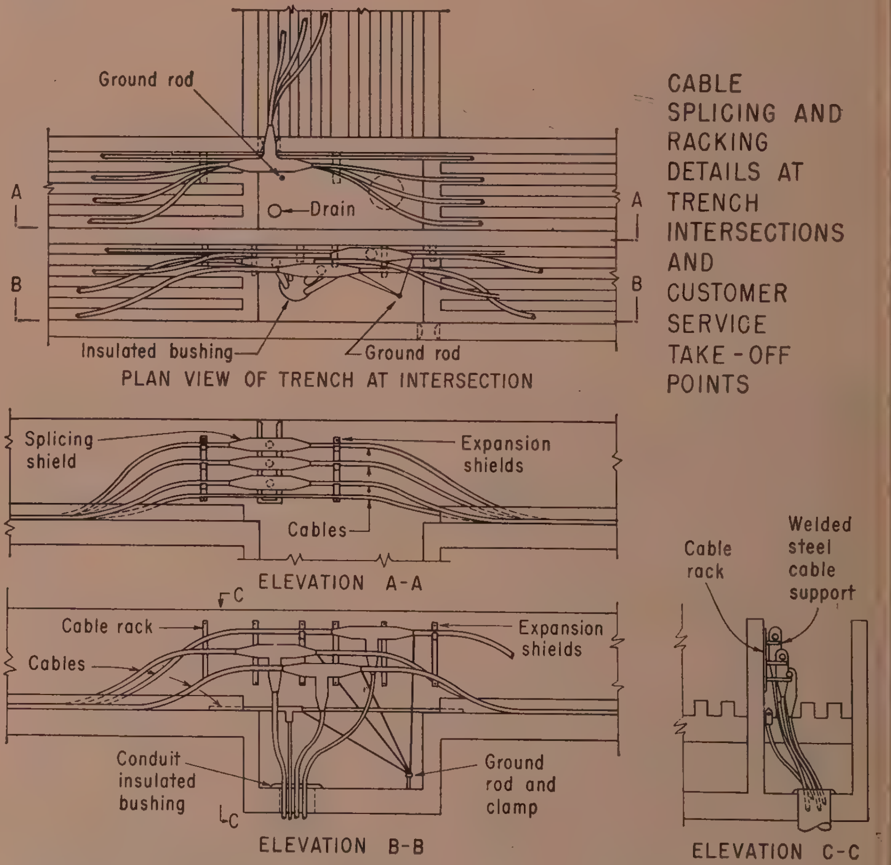
The underground distribution system connects with an overhead utility supply line through a galvanized steel conduit carried up the terminal pole to a height of 16 ft aboveground then through asbestos-cement duct upward to just below the terminal potheads, fuse cutouts and lightning arrestors. Cables are supported and sealed at the top of the duct. Conduits and neutral wires bond to a common ground.

This installation serves Overlake Park, located just east of Seattle. Conceived as a self-contained metropolitan satellite, foundations are being placed for a large number of homes, small industrial plants, research labs, retail stores, churches, a hospital, professional offices, schools and shopping centers.

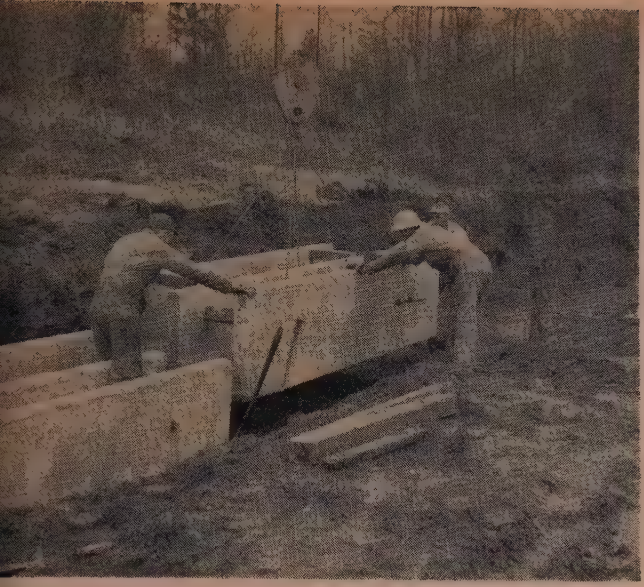
This idea of boxing primaries "under foot" in prefabricated cableways was developed by Puget Power & Light Co. engineers. The installation was assigned to the Industrial Electric Co., Seattle, Wash., under a prime-contract agreement.


Drain holes cast in floor of trench
Expansion joint
End section with 6" steel conduits to pass beneath roadway
Bottom of service pit slopes toward drain
Service opening
PLAN OF POWER TRENCH
Grout
Raised concrete partitions between grooves
Drain
Gravel base
Brackets to support splicing shields or additional conductors
Drain hole
6" conduit for customer service
Non-extruding pre-molded filler between sections
Smooth steel dowels. Half painted, greased and equipped with expansion cap
A-A
B-B
C-C
D-D
SIDE ELEVATIONS
Reinforced concrete cover with stepped shoulder to prevent lateral shifting
6"
1"
2⅝"
2½"
2'-0"
6"
X-X
4'-0"
4"
1'-6"
1'-6"
4"
3⅝"
4'-0"
1'-0"
6"
Y-Y
Note: Details of reinforcing bars omitted for sake of simplifying drawings
CROSS SECTIONS

**DETAILED SKETCH** shows features of standard trough and cover sections, customer service pits, sloping terminal sections, drains, expansion joints and grouted conduit connections.



**T-SHAPED SPLICING SHIELDS** are mounted either vertically or horizontally, depending upon whether connections are for customer service or for connection to intersecting feeder. Note details of cable racks and welded steel supports on side walls, also position of ground rod, drain and bushed conduit in bottom of pit.

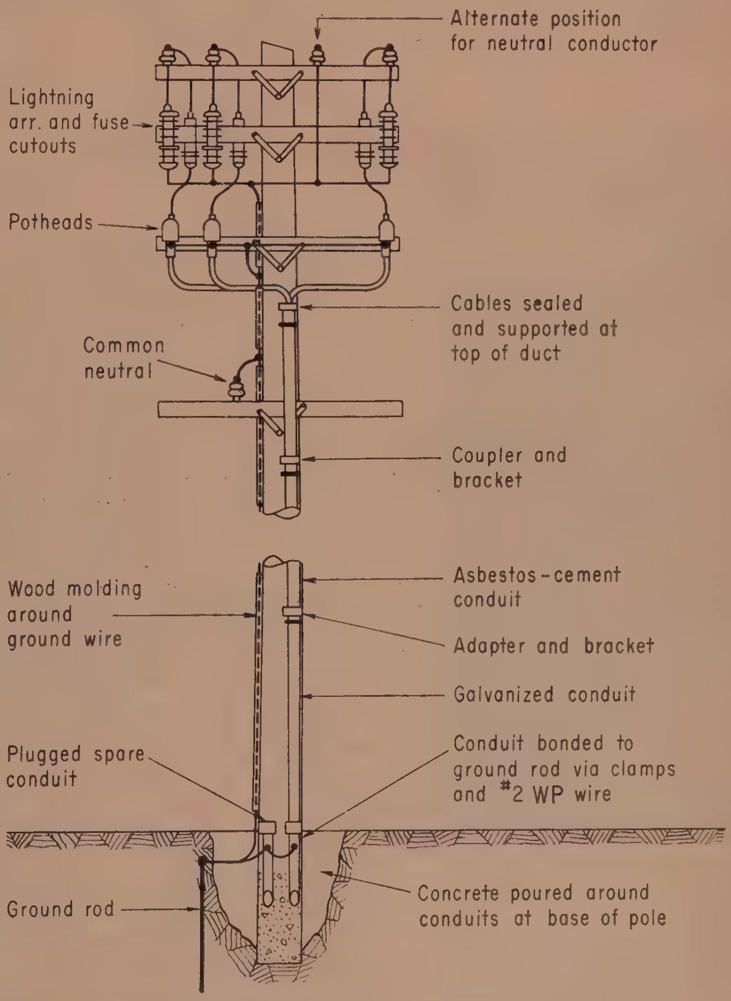


**TAMPED GRAVEL BED** of trench was accurately leveled to insure exact slab elevation atop completed distribution system. Steel dowels were then inserted into holes in abutting endplanes, premolded membranes were positioned, and sections were snugged into close contact.

**HEAVY COVERS,** each weighing 3350 lbs, are lowered into position after cable-laying. Gaskets are placed between end surfaces before covers are snugged together. Note special sling arrangement attaching to rods inserted temporarily into slab, also stepped shoulders to prevent lateral shifting.

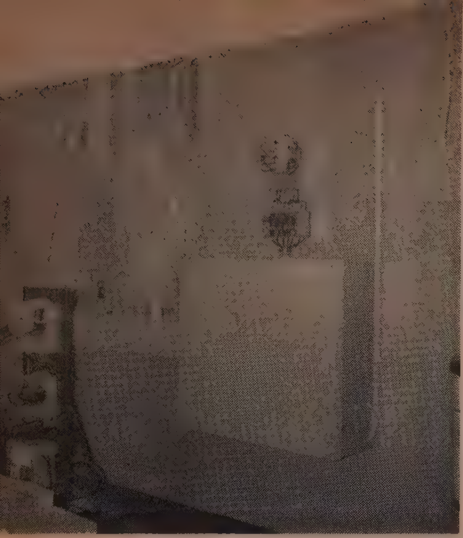
**PRECAST PIT,** for customer service connection, contains central ground rod for connection with splice sleeves, side brackets for support of primaries and T-taps.

**TROUGH STOPS** at street intersections, with sloping terminal section carrying cables downward to 6-in. dia conduits that pass under roadway then reconnect with similar trough section on other side.


Alternate position for neutral conductor
Lightning arr. and fuse cutouts
Potheads
Cables sealed and supported at top of duct
Common neutral
Coupler and bracket
Wood molding around ground wire
Asbestos-cement conduit
Adapter and bracket
Galvanized conduit
Conduit bonded to ground rod via clamps and #2 WP wire
Plugged spare conduit
Ground rod
Concrete poured around conduits at base of pole

TERMINATION AT POLE

**UTILITY** line is tapped at terminal pole as shown. Connecting cables enter conduit drop sealed cable support then under roadway to connect with sidewalk power trough.



**SERVICE EQUIPMENT** for the residence is shown here. Service entrance conductors are run underground in conduit from an outside utility pole. A 3-in. conduit carries four 4/0 RHW-insulated conductors and one 4/0 bare copper conductor. Two insulated conductors are used in multiple for each hot leg of the 120/240, 3-wire, single-phase supply, and the bare conductor is used for the grounded neutral. The underground conduit feeds into the back of the large CT cabinet at right. SE conductors are then carried into the gutter shown from which tap conductors are run up to the 200-amp main CB in each of the two distribution panelboards shown. The panelboard at left supplies branch circuits for lighting and appliances in the house (including range top, double oven, clothes dryer, disposal unit, water heaters, kitchen receptacle outlets). The panel at right supplies circuits for all electric heating (space and driveway) and for air conditioning units. The metering setups at left are temporary installations made by the utility company to study the heating load. Panel assembly at far left controls operation of the lawn sprinkling system. Bare ground wire for system is run in thinwall from right side of CT cabinet up and over to street side of water meter.

## *All-electric utilization adds up to . . .*

# 115-KW Load in Residence

No compromise was made in the electrification of this 3-bedroom, one-story home in New Jersey. And the owners attest to the highest order of living comfort and convenience, with operating cost running under the design estimated value.

**By J. F. McPartland**

**CORNER OF DEN** reveals number of facilities: sloped ceiling contains heating wire in plaster between beams; air conditioning outlet is at upper left; dual R-lamp lighting fixture with swivel housings affords variety of lighting effects in corner; lighting control switches and receptacle outlets are at bottom of photo; intercom and music system station, with controls, is mounted in wall; thermostat for ceiling space heating in this room is at right of intercom station.

A NEW residence in Clifton, N. J., boasts an unusually high level of electrical utilization. Here, a 400-amp, 120/240-volt, 3-wire, single-phase service feeds a connected load of 115 kw. The total load covers the full-scale of electrically operated comfort and convenience devices — electric space heating, water heating (including instant boiling water), driveway snow removal, cooking, air conditioning, laundry equipment, humidity control, wide variety of lighting, lawn sprinkling, intercom and music distribution and other appliances.

The house itself has a living room, dining room, kitchen, den, three bedrooms and an entrance hall on the first floor. The basement of the house contains a 2-car garage, a large recreation room, a laundry room and a utility room. The house was designed in all details—including electrical work—by M. Leonard Levine, architect, Passaic, N. J. He was retained by the owners of this distinctive residence to design and supervise construction and decoration of the house. The architect explained the advantages of all-electric living to the owners, and they gave him the "go-ahead" for a total job. The electric heating system and thermal insulation of the house was designed by the Electric Heat Co., Paterson, N. J.

Puzio Bros., electrical contractors, Wallington, N. J., made the electrical service installation and wire loads and outlets other than the electrical heat. Colite of Clifton, N. J., installed the electric heat.

Electric space heating throughout both levels of the house is provided by plastic-insulated heating wire embedded in the ceilings. The approach was the same in each room. The heating wire was stapled to the ceiling rock lath, with the wire run back and forth on uniform spacing to form a complete heating grid pattern on the ceiling. The cable was then covered with plaster to form the finished ceiling.

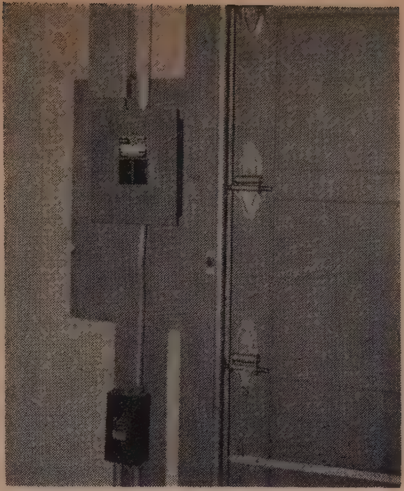
For each room, a heating calculation was made to determine the watts input required to match the heat loss characteristics of the room. Then a standard length of 240-volt heating wire with a "watts" rating at least equal to the required watts input was selected for the room. It was then a matter of uniformly distributing this length of wire in a ceiling grid pattern.

The standard pre-engineered lengths of heating wire come on spools with a length of non-heating cable spliced to each end of the heating wire to run from the ceiling down to the wall thermostat controlling operation of the heating wire. These non-heating power leads are single-conductor type UF cable for installation in stud space without the use of loom or raceway. This use of type UF is prohibited for general use by NEC Sec. 339-3 (d), which requires multiple conductor UF when used as non-metallic sheathed cable.

Each room is individually thermostatically controlled with armored cable used for all wiring from thermostats to the distribution panel. The line-voltage thermostats are mounted on inside walls.

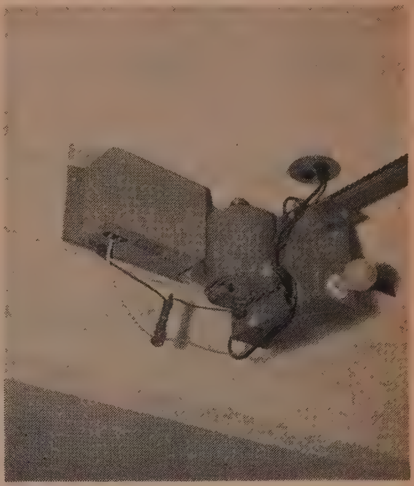
Thermal insulation is a carefully considered feature of this house. Cellulose fiber insulation was blown into the stud spaces of all outside walls, into the joist spaces above the first floor ceiling and into the joist spaces of the basement ceiling. Sidewalls were filled to the full 3⅝-in. depth of the 2 by 4 studs; 8 in. of insulation are in the first floor ceiling; and 8 in. of insulation are in the joist space above the basement ceiling. The insulation above the first floor ceiling serves the conventional func-

(Continued on page 114)



**DRIVEWAY SNOW REMOVAL** is accomplished by three heating wire lengths woven on chicken wire and embedded in a rectangular pattern to cover the 24 ft by 45 ft concrete driveway to the 2-car garage. A subfeeder from the heating distribution panel in the utility room is run to the sub-panel shown (at left) in the garage. One 40-amp, 2-pole CB in this panel protects a 220-volt circuit of two No. 8s feeding up in ¾-in EMT and over to a JB (photo at right) on the wall between garage doors, where the cold leads from two 4300-watt heating wire elements are connected to the circuit. A 20-amp 2-pole CB in the subpanel protects another circuit feeding down out of the panel to supply the third 4300-watt driveway heat wire. The enclosure shown below the panel (photo at left) and the two enclosures below the JB (in photo at right) house thermostats (one for each heat wire element) to open the heating circuits when the temperature at the interior of the concrete driveway reaches 80°. These thermostats operate automatically from sensing devices embedded in the concrete. Operation of the snow removal system is manually controlled by ON-OFF positioning of the panel CBs.

**GARAGE THERMOSTAT** on garage wall is pointed out by M. Leonard Levine, architect of the residence. Heating wire in ceiling heats the 2-car garage. The two walls of the garage which adjoin living areas in the basement are fully insulated for the depth of the stud space. The garage ceiling is also insulated. The two small pushbutton switches above the thermostat are low-voltage devices which provide manual control of the motorized garage-door operations. Two switches below the thermostat control ceiling lights in the garage.



**DOOR OPERATOR** for each overhead-lift garage door is a plug-connected, radio-controlled, motorized unit. Each door operates on its own radio frequency. Each of the two cars kept in the garage has its own transmitter which controls operation of the door operator for one side of the garage. When the operator opens the door, the light is turned on. When the operator closes the door, the light is turned off. This light on each door operator may be operated (with the motor) from the radio transmitter in the car or from the pushbuttons on the garage wall. These lights are used in conjunction with the standard ceiling lights in the garage to provide lighted access into and out of the garage.

**MERCURY** floodlighting provides a new dramatic lighting effect to the crown of the Ford Rotunda, automotive exhibit building in Dearborn, Mich. The new lighting system consists of 242 wide-angle floodlights, each using a 250-watt mercury vapor lamp.

### *Mercury Units*

# Improve Floodlighting Efficiency

New mercury floodlights on Ford Rotunda in Dearborn, Mich., provide 45 lumens per watt compared with six lumens per watt for old incandescent units which they replaced.

WIDE-ANGLE mercury lamp floodlights were installed on the Ford Motor Company's Rotunda exhibit building in Dearborn, Mich., in order to replace incandescent lamp floodlights which have been in use since 1953 to floodlight the exterior of this building. The mercury units were installed in order to obtain more efficient exterior lighting of the Rotunda, and to achieve a dramatic floodlighting effect more economically.

The former installation of incandescent floodlights consisted of 150-watt type A-25 inside frost standard lamp reflector units, mounted on a special angled wireway housing custom-made for the job, and spaced on approximately 10-in. centers. Each reflector was also equipped with a dense amber color lens. Light output of the 150-watt standard lamps when new is about 18 lumens per watt, or 2700 lumens per lamp. Considering the light loss in the reflectors, which were deteriorated to considerable extent, and in the amber lenses due to absorption, it was estimated that the over-all efficiency of the old installation was about six lumens per watt. Not only were the units inefficient, but the rated lamp life of these lamps is only 750 hours, and this contributes to costly maintenance and operating expense.

Taking these factors into consideration, company officials called in L. H. Beck, of the Detroit firm of L. H. Beck Electric Sales Co., for consultation. After study and analysis of the problem, with the cooperation of Carl Carlson of Graybar Electric Co. of Detroit, Beck estimated that mercury lighting could be installed to replace the incandescent system, and that savings of approximately $7,500 in the annual operating expense of the floodlighting system might be expected. The analysis is shown in the table "Cost Comparison Between Mercury and Incandescent."

Installation cost of the proposed new mercury lighting system, for the three tiers of the circular structure only, was listed as $17,434. Based on operating eight hours a day, the new system would pay for itself in 2 years, 4½ months, and save $615 monthly thereafter, according to the study. And if the system is operated 12 hours a day, the mercury installation would pay for itself in only 19 months, and provide a monthly savings of $930 thereafter.

The installation of the mercury floodlights was approved, and was made by mechanics of the power and utility services of the company, with L. H. Beck as consultant.

The complete installation as finally made consists of 192 mercury floodlight units installed in the central circular portion of the Rotunda, and 48 similar units installed to light the top part of adjacent wings. These units have a light output of 45 lumens per watt, and each unit replaces ten of the old incandescent units.

The old incandescent floodlighting was installed in 1953, and consisted of 2,330 150-watt units arranged in tiers, and along the upper part of the wings. The tiers were lighted by 1,920 units, and the wings by 510 units.

The Rotunda was originally an automotive exhibit building in the Chicago "Century of Progress" World's Fair, 1933-34. When the Fair closed, the Rotunda was dismantled and moved to Dearborn, where it was reconstructed as a permanent exhibit building. In 1953 a roof was constructed over the center court of the Rotunda, enclosing this area and providing more floor space for exhibits. The incandescent lighting system was also installed at that time. Now, after eight years of use, that system has been replaced by the new and more efficient mercury lamp installation. The Rotunda now shines with a new brilliance, of distinctive color, and at considerable savings in maintenance and operating costs.

## FLOODLIGHTING OF FORD ROTUNDA, DEARBORN, MICH.

(Cost Comparison Between Mercury and Incandescent)

| | MERCURY | | INCANDESCENT | |
|---|---|---|---|---|
| No. of floodlights | 192 | | 1920 | |
| Wattage/floodlight | 267* | | 150 | |
| Rated lamp life (hours) | 12,000 | | 750 | |
| Total electrical load (watts) | 51,264 | | 288,000 | |
| | 8-hr/day | 12-hr/day | 8-hr/day | 12-hr/day |
| Estimated use per year (hours) | 2920 | 4380 | 2920 | 4380 |
| **Cost of Maintenance (4-year period)** | | | | |
| Number of relampings | 1 | 1.45 | 15.5 | 23.4 |
| Cost of labor (4-year period) | | | | |
| Mercury @ $1/lamp | $192 | $278 | ......... | ......... |
| Incand. @ 50¢/lamp | ....... | ....... | $14,880 | $22,464 |
| Cost of lamps (4-year period) | | | | |
| Mercury @ $11.97 | $2,298 | $3,332 | ......... | ......... |
| Incand. @ $0.205 | ....... | ....... | $6,100 | $9,210 |
| **Cost of Electric Power (4-year period)** | | | | |
| Power Consumed | | | | |
| Kwh/year | 149,691 | 224,536 | 840,960 | 1,261,440 |
| Kwh/4-year period | 598,764 | 898,144 | 3,363,840 | 5,045,760 |
| Power cost (@ $0.004/kwh) | $2,395 | $3,593 | $13,455 | $20,183 |
| **Total Maintenance and Power Cost (4-year period)** | | | | |
| Cost (Maint. & Power) | $4,885 | $7,203 | $34,435 | $51,857 |
| Total savings (Mer. Vs. Inc.) | ....... | ....... | $29,550 | $44,654 |
| Savings per month | ....... | ....... | $615 | $930 |
| Cost of mercury installation (Equipment plus labor) | $17,434 | | | |

Mercury installation will pay for itself . . .
@ 8 hours use per day, in 2 years-4.5 months
@ 12 hours use per day, in 1 year-7 months.

*Lamp consumes 250 watts, ballast consumes 17 watts.

**ELECTRICIANS** make final adjustments of the new mercury lamp floodlights on top tier of the Rotunda. The mercury units each replace ten of the old 150-watt incandescent units, shown attached to the angled and curving wireway housing.

• *ESTIMATING FORUM—XXII*

# Analyzing Reported Costs Of Proposed Projects

## Part I—Preliminary Studies

By **Ray Ashley**, *Research and Consulting Engineer, Oak Park, Ill.*

**STATEMENT:**

An estimator must be able to readily appraise reported costs for new building construction. Given the estimated cost of the electrical work, he must be in a position to quickly supply approximate figures for the following:

1. Base Costs
2. Man-Hours Labor
3. Manpower Demands
4. Duration of Project
5. Time Required for Estimating the Work

Preparatory work will be studied in this article. Later, analyses of specific projects will be made. Preliminary studies and preparatory work not only pave the way for analyzing costs, but provide an education in cost distribution that should be common to all estimators.

**QUESTIONS:**

1. ***What materials are useful for the purpose of analyzing reported costs?***
2. ***Do experienced estimators have to rely on compiled tables and charts when analyzing reported costs?***

**ANSWERS:**

1. ***Useful materials include:***
   ***a. Reference tables prepared for the purpose.***
   ***b. Studies prepared by others.***
2. ***Estimators do not always have to rely on compiled tables and charts. From long experience, they learn the approximate division of costs and length of duration for various sizes and types of projects.***

**DISCUSSION:**

Before launching into the discussion, let's become acquainted with abbreviations used in the subsequent text and tables. These include:

DJC—Direct Job Costs
INS—Insurance
OH—Overhead
MH—Man-Hours
MLR—Material-Labor Ratio
MPR—Man-Power Requirements
MU—Markups
RET—Return (anticipated profit)

### *Compiled Tables*

The handy reference table in Fig. 1 is designed to aid, with the help of established multipliers, in the rapid analysis of the estimated contract price or reported cost of a project. Col. 1 lists a number of project sizes based on contract price. Cols. 2 through 8 show recommended percentage markups for direct job costs, overhead, insurance and return applied to material and labor for the various sized projects. The overhead values in Cols. 3 and 6 are for reference only. They are modest but consistent with practice when the better projects are being estimated.

**FIG. 1—Multipliers Applied to Contract Price**

For Complete Installations with 60/40 MLR and $4.00 per hr. Labor Rate

| CONTRACT PRICE (Dollars) | MARKUPS USED | | | | | | | MULTIPLIERS (Unit × Contract Price) | | | | HOURS LABOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MATERIAL MU (%) | | | LABOR MARKUP (%) | | | | | | | | |
| | DJC | OH* | RET. | DJC | OH* | INS. | RET. | Base Cost THE JOB | Base Cost MATERIAL | Base Cost LABOR | LABOR HOURS | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 7,000 | 3 | 10 | 8 | 8 | 35 | 10 | 10 | 0.704 | 0.422 | 0.282 | 0.071 | 500 |
| 13,500 | 3 | 8 | 6 | 7 | 28 | 10 | 10 | 0.741 | 0.445 | 0.297 | 0.074 | 1,000 |
| 26,200 | 2 | 7 | 5 | 6 | 25 | 10 | 10 | 0.765 | 0.458 | 0.307 | 0.077 | 2,000 |
| 39,000 | 2 | 7 | 5 | 6 | 22 | 10 | 10 | 0.770 | 0.462 | 0.308 | 0.077 | 3,000 |
| 64,500 | 2 | 6 | 5 | 6 | 20 | 10 | 10 | 0.776 | 0.466 | 0.310 | 0.078 | 5,000 |
| 96,000 | 2 | 5 | 5 | 6 | 18 | 10 | 10 | 0.782 | 0.468 | 0.313 | 0.078 | 7,500 |
| 127,000 | 2 | 5 | 5 | 6 | 17 | 10 | 10 | 0.788 | 0.474 | 0.315 | 0.079 | 10,000 |
| 315,000 | 2 | 5 | 5 | 6 | 15 | 10 | 10 | 0.794 | 0.476 | 0.318 | 0.080 | 25,000 |
| 625,000 | 2 | 4 | 5 | 6 | 14 | 10 | 10 | 0.800 | 0.480 | 0.320 | 0.080 | 50,000 |
| 930,000 | 2 | 4 | 5 | 6 | 13 | 10 | 10 | 0.806 | 0.485 | 0.322 | 0.081 | 75,000 |

Abbreviations:
DJC—Direct Job Costs
INS.—Insurance
OH—Overhead
MLR—Material-Labor Ratio
MU—Markups
RET.—Return (Anticipated Profit)

*—Overhead values from "Electrical Contracting," McGraw-Hill Book Co.

The right half of the table (Cols. 9 through 12) lists the multipliers used to analyze projects on the basis of contract or reported price. By using these multipliers, the estimator can quickly determine the job base cost, material base cost, labor base cost, and even the labor hours (Col. 13). From the labor hours, he can easily determine the normal duration of the project.

## *Use of Multiplier*

To illustrate the use of the multipliers in Fig. 1, let's analyze a project with a $39,000 contract price. Using the figures in Cols. 9 through 12, we have respectively:

Base Cost of the Job—0.77 × $39,000 = $30,030 (use $30,000)

Base Cost of Material—0.462 × $39,000 = $18,018 (use $18,000)

Base Cost of Labor—0.308 × $39,000 = $12,012 (use $12,000)

Total Labor Hours—0.077 × $39,000 = 3,003 (use 3,000 hours)

A word of caution to the novice estimator. The multipliers in Fig. 1 are to be used for the purpose of analyzing reported costs. *They are not to be used for estimating work.*

An error of 10% in the analysis of a proposed project is not so serious, but a 10% error in the estimated cost when figuring a job may be disastrous.

## *Developing the Multiplier*

Fig. 2 shows the basic method used to develop the multipliers. Again, the $39,000 project is used as the example. Markups noted in the left half of Fig. 1 were applied to relevant cost items. The final result showed a contract price that was 130% of the base job cost.

(Continued on page 116)

**FIG. 2—Developing Multipliers For Contract Price**

($39,000 project, 60/40 MLR, using markups in Fig. 1)

Base Job Cost—100%

Division of Base Job Cost—Material 60%, Labor 40%

**The Estimate:**

| | | **Material** | | **Labor** |
|---|---|---|---|---|
| Base Costs | | 60.00 | | 40.00 |
| Direct Job Costs | 2% | 1.20 | 6% | 2.40 |
| Complete Job Costs | | 61.20 | | 42.40 |
| Overhead | 7% | 4.28 | 22% | 9.33 |
| Insurance (10% of Base Labor) | | ...... | | 4.00 |
| Contract Costs | | 65.48 | | 55.73 |
| Return | 5% | 3.27 | 10% | 5.57 |
| Est. Contract Price—Material | | 68.75 | | 61.30 |
| Est. Contract Price—Labor | | 61 30 | | |
| Est. Contract Price—The Job | | 130.05 | | |

**Multipliers:**
Job Base Cost—1/130 = 0.770
Material Base Cost—60% of 0.770 = 0.462
Labor Base Cost—40% of 0.770 = 0.308
Labor Hours ($4.00 rate)—¼ × 0.308 = 0.077

ELECTRIC
HEATING
FORUM

# Heating with Infrared

A detailed look at infrared comfort heating, including sources, fixtures, physiological factors, capacity requirements, methods of control, and markets. First of two parts.*

MAN'S dependence upon the sun as his only source of warmth was his first contact with infrared radiation. He learned he could dry animal skins, food, wood and pottery by exposure to direct sunlight. Later, he discovered fire, learning to control its intensity and duration to do the same tasks the sun did for him. In addition, this new source of radiation could cook foods, keep him warm at night, and be made available where and when it was needed.

The wood-burning stove began to supplement the fireplace in the nineteenth century, adding the principle of convected heat to that of radiation. Around the turn of the century, electric wiring in homes, factories and offices encouraged the development of portable electric heaters using incandescent lamps or resistance wire backed by a suitable reflector to direct the radiated heat in the desired direction. This direction capability, coupled with the fact that infrared radiation warms only the objects which intercept it and not the intervening air, has led to its extensive use for what is variously described as *people*, *comfort*, or *spot* heating.

### *Infrared Sources*

Today, much-improved electrical sources of infrared energy are available. These include two types of lamps and various devices employing resistance wire elements. Each of these suits certain applications better than the others. Knowledge of their characteristics will facilitate selection.

*Infrared Lamps:* Two basic lamp types predominate for comfort heating: the tubular quartz T-3 (⅜-in. dia) lamp, and the glass, reflectorized R-40 (5-in. dia) lamp. Both types have tungsten filaments designed for 4000F operation at rated voltage, making them radiators of the so-called "near" infrared energy. The term *near* is used to indicate the relative position of the lamp's infrared radiation with respect to the visible spectrum. About 5% of the radiated output from infrared lamps is visible light —roughly ⅛ that of lamps used for lighting. For outdoor and indoor comfort heating applications the additional illumination provided by heat lamps is often welcomed, particularly since it comes at no additional cost. Both lamps offer instant radiant heat, reaching full operating temperature in less than a second. Popularity of the R-40 lamp with built-in reflector is due to the ease of installation—all that is needed is a porcelain screw socket. About the home, for example, R-40 heat lamps are found in garages, work shops, bathrooms, porches and recreation rooms.

The long, slender T-3 lamp in the sealed translucent quartz tube is effective for medium or high mounting heights or where high wattage densities are required, since it is loaded at 100 watts per in. of filament length. The T-3 lamp does not include a reflector as does the R-40; therefore special equipment has been designed to direct its radiation.

*Resistance Heaters:* Sources having resistance wire elements include those using a simple straight or coiled wire mounted on ceramic insulators, and those using heating wire confined within quartz, silica quartz, or metal tubing or metal castings.

Quartz tubes, which are closed but not sealed off from the atmosphere, are available in tubing diameters from ⅜ to 1 in. Although they have the same general appearance as the quartz lamps described above, there is considerable difference between the two. Because the hot wire cannot be sealed off from the atmosphere, a loading of 40 watts per in. of element length is the practical limit for quartz tubes of ⅜-in. diameter, restricting the operating temperature to about 1900F. They glow at an orange-red color and have a heat-up time of about two minutes.

Heat-transfer theory and actual measurements indicate that the radiated energy component of such lower-temperature sources is approximately 64% of the input wattage, as compared with the 86% radiated by the quartz lamp. This may or may not be significant in actual application, since housing and reflector design, mounting details, and air movement all affect the amount of radiation actually reaching the person or persons to be heated.

Metal sheath heaters are used in convection and radiation type heaters. They offer the maximum in ruggedness and as a result are frequently used in several kinds of commercial and industrial portable heaters. Sometimes the heaters are mounted on dollies to permit easy movement into service when needed. Metal sheath equipment is often used for spot heating applications where it is positioned at less than head height and sometimes on the floor.

---

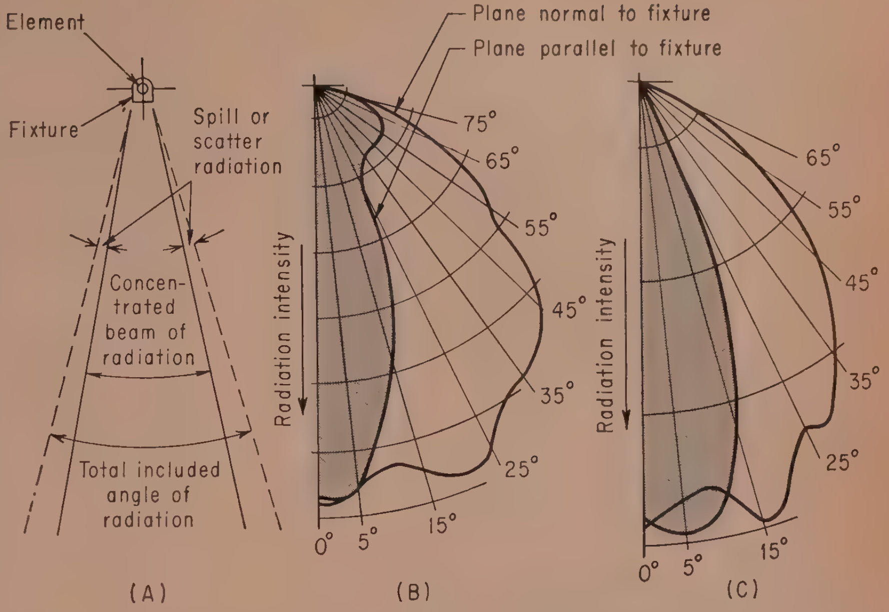
* Adapted from papers presented at NEMA's Second Electric Comfort Heating Exposition & Symposium in Chicago, March, 1962, by R. L. Boyd, Edwin L. Wiegand Co.; W. R. Stephens, General Electric Co.; and W. J. Novak, El C & M.

## FIG. 1. Fixture Radiation Patterns

(A) Fixture configuration will direct most of the radiation downward in a concentrated beam, although some "spill" or "scatter" radiation will be in evidence outside this beam.

(B) Radiation pattern of typical shallow fixture shows a concentrated angle of about 50° (25° on each side of center line), with spill increasing the total angle of radiation to about 150°. These angles are based on intensity measurements made in a plane normal to the fixture.

(C) Special fixture design almost eliminates spill, decreasing the concentrated angle to 45° and the total angle to 53°. The irregularities of both patterns in plane parallel to lamp are probably due to spacers supporting the element. The slight dip in intensity immediately below the fixture is due to the element itself interfering with reflected radiation.



These heaters require several minutes to reach operating temperatures. Normally designed for approximately 50 watts per in. in a $\frac{3}{8}$-in.-dia tube, operation is over the range of 1200F to 1800F. Their appearance when up to temperature is also an orange-red.

Except for the metal sheath heater, which may be operated in any position, these tubular heaters are generally restricted to horizontal operation. The quartz lamp may be obtained on special order with specially designed filament supports for vertical mounting where the application demands it.

### *Infrared Fixtures*

Generally speaking, infrared lamps and fixtures permit reasonably good control of the radiant energy; it may be aimed to those target areas where it is needed. The R-40 lamp has a desirable symmetrical beam pattern and presents little difficulty. The long, slender, straight shape of the quartz lamps, quartz tubes and metal sheath heaters makes lengthwise control difficult, although sharp reflector control in the crosswise direction is readily achieved.

Such tubular elements are frequently applied in shallow fixtures with concentrated beams of radiation between 30 and 90 angular degrees (Fig. 1A) but with spill or scatter radiation typically extending on each side of the concentrated beam so that the total included angle of radiation is from 150 to 160 degrees.

Fig. 1B is a graphical presentation of the distribution curves of energy from such a fixture measured on two planes: the plane normal to the lamp and the plane parallel to the lamp. Note that the greatest intensity of radiation is experienced between 0 and 30 deg from the vertical, giving a concentrated angle of 60 deg. Spill or scatter radiation extends the angle of radiation some 45 deg beyond the concentrated beam, giving a total angle of about 150 degrees.

The spill or scatter radiation is usually beneficial for close mounting (10 ft or less from fixture to target), particularly for comfort applications. At these closer distances, it is not desirable to have the sharp cut-off in radiation as one moves from the specific pattern provided. The spill or scatter radiation tempers the vicinity of the more concentrated radiation and avoids the sensation of moving abruptly from the heated to the unheated area. However, for mounting distances greater than 12 ft between fixture and target, the spill or scatter is a disadvantage, since most of this portion of the radiation usually strikes above the working level and is essentially lost. The typical over-all delivery efficiency of such a fixture is 75 to 80% of the energy input delivered as visible light and infrared energy in the pattern shown.

Deeper fixtures permit more narrow beams with a concentrated angle from 30 to 60 deg and spill or scatter of only 5 to 10 deg more (Fig. 1C). Such fixtures are beneficial for distant mounting (12 to 50 ft) since more of the radiation produced is directed into the desired pattern. The narrow beam permits coverage of the same area from a greater distance, or provides a greater concentration in a smaller area from the same distance. The typical over-all efficiency of delivery of the deeper fixtures is 65 to 75% of the input energy delivered. Use of the wrong fixture type can thus negate any advantage in radiation efficiency gained through choice of element.

### *Physiological Factors*

Application of these infrared sources to comfort heating requires some knowledge of the thermal interchanges between man and his environment. The average man seated and at rest dissipates roughly 400 Btu per hr, which is about 120 watts. The breakdown of this energy shows he loses about 25% of this total through evaporation, and the balance by skin convection and radiation. These percentages can vary widely with environmental changes, as can the body heat output, depending upon the degree of activity. For example, walking at 2 mph increases body heat to about 800 Btuh. Under conditions of high ambient temperatures in still air, loss of heat from the body is predominantly by the process of evaporation. Heat production during maximum exertion can be 20 times as great as during sleep.

These principles suggest that comfort may be provided at different levels of room temperature, depending upon the degree of activity involved. A very active factory employee can be comfortable in a 55F ambient temperature, whereas the seated office clerk prefers 70F. In either case, discomfort in the form of perspiration or chill can result if the temperature is not maintained within a few degrees of the comfort value.

Body heat losses by convection and evaporation are rather easily understood. Both are dependent on average skin temperature, air temperature, and air movement; and evaporation involves relative humidity in addition.

Radiation loss is more complex, partly because it involves the *mean radiant temperature.* All objects, whether they be people, animals, machine tools or buildings, radiate energy to their surroundings. The amount of radiation given off and received is governed by the temperature and area of the object surfaces and also upon their ability to interchange energy. Theoretically, after sufficient time for radiation, absorption, re-radiation and reflection, all objects should reach a stable temperature condition. In actuality, changing weather conditions prevent it.

Under normal, comfortable environmental conditions the temperature of man's exposed skin and clothing is 83F. Since that is above the temperature of the objects about him, he radiates heat to the ceiling, walls, floor and such items of furniture or machinery that might be in the space. It is true that these objects are also directing radiation at the man, but because they are usually at a lower temperature, his body loses more energy than it gains. One object—say a lighted fireplace—will supply radiation to a man, while the cooler room surfaces will accept radiated heat from both the man and the fireplace.

A person seated on a stool with his back close to a large picture window during cold weather provides an example of how radiation can produce discomfort. He will soon have the sensation of heat being "siphoned" away from the back of his head and neck, and possibly his shoulders and back. His front side is not chilled because it is not exposed to or "seen" by the cold window.

Comfort can be restored in several ways: the persons can move to the other side of the room, draw the drapes, put on an overcoat, muffler and hat, or substitute a high-backed chair for the stool. All these remedies subdue the effect of the cold window, but actually the problem was relieved in just two ways—by improved room radiation geometry, or by use of radiation screens or insulation.

The foregoing makes clearer the meaning of mean radiant temperature. It may be described as the hypothetical uniform temperature of all surface areas surrounding a man at a specific location which would produce the same exchange of radiant heat between the man and his surroundings as does the actual existing room. The concept suggests the *idea* of a uniformly heated sphere with a person at its center.

A formula established by Raber and Hutchinson, two well-known authorities in the field of radiant heating, relates air temperature and mean radiant temperature under comfort conditions:

$$T_{air} + T_{MRT} = 140$$

The equation indicates, for example, that equal comfort can be maintained in a 60F air temperature with an 80F mean radiant temperature or vice versa.

Mean radiant temperatures *higher* than air temperatures represent a new concept. Inherent in prevalent convection-type, centralized warm air heating systems are air temperatures warmer than wall temperatures.

How can a condition be created where the mean radiant temperature exceeds the air temperature? It could be accomplished by a number of fireplaces located around the room. Another approach would be low-temperature heating cable buried in all the room surfaces. The *new* approach is installation of infrared comfort heating equipment on the ceiling in much the same way that lighting fixtures are mounted. Such heating equipment will increase the mean radiant temperature of the overhead area. In addition, the radiation projected downward will warm the floor, machinery, people and lower wall areas intercepting it, thus raising the mean radiant temperature throughout the space. The air will be heated too, but indirectly by convection as it moves over the warm floor and other objects.

With this different method of over-all room heating, not only can the body radiation loss be reduced; the body can also gain heat by radiation incident to the skin and clothing. The warming effect of the direct energy received by a person has the effect of reducing the mean radiant temperature needed for comfort at a given air temperature.

This is an important concept. The use of infrared energy aimed directly at a target area makes it possible to provide much-improved comfort to persons working in outdoor or semi-outdoor environments. Furthermore, this direct heating technique permits "spot" or "zone" heating of small areas in otherwise unheated buildings.

### *Capacity Requirements*

For comfort heating, radiation should be applied from at least two directions, neither directly overhead, with adequate radiation of the lower extremities as well as the head and shoulders. It is obvious that only a small portion of the approximately 19½ sq ft of exposed area on the average clothed body would be radiated by a fixture directly overhead. The top of the head and shoulders represent a very small area, and the balance of the body is substantially all in the shade. Moving off to the side with one element radiates much more nearly half of the available surface area, while radiating from two opposite directions covers substantially all of the area. However, even better results can be secured by radiating from all four sides, or even from three where all four are impractical. Since the heaters are usually located overhead, the head and shoulders are usually much closer to the heaters than the central parts of the body and the lower extremities. The phrase "Hot heads and cold feet make unhappy workers" can be a reminder that attention needs to be paid to radiating all parts of the body, and because of the generally closer proximity of head and shoulders to the fixtures, the floor around the subject would ideally be well radiated to add its influence to warming the central and lower parts of the body.

The outside design temperature is significant only so far as it influences the lowest inside temperature which the infrared is intended to overcome. Infrared is not an air heater. Only a small fraction of the infrared energy passing through air is absorbed by carbon dioxide, water vapor, dust, etc., so that air is warmed only slightly by the passage of infrared energy through the air. The function of infrared is to produce relative comfort despite a lower than normally comfortable ambient temperature. The floors of large areas do not become nearly so cold as minimum outdoor temperatures and in most areas seldom if ever get below freezing, even in unheated buildings. Outside design temperature is not significant in infrared design. The real design factors are the lowest ambient in which the system is to be called upon to provide relative comfort and the wind or draft conditions under which such relative comfort is to be provided.

Many infrared installations heat specific work stations without attempting to raise the temperature of the ambient air, and without particular regard for the heat loss of the structure itself. Indeed, these work stations may be without an enclosing structure. However, there are also complete heating applications where infrared units may be used with advantage. These usually involve the heating of a distributed group of people in an enclosure having a relatively large floor area and a high ceiling, where attempting to effect heat transfer by heating the air would be impractical and prohibitively costly.

For such total building or large-area heating, a variety of methods of arriving at capacity requirements are in current use. They range in value from ¼ to ¾ watts per sq ft per degree rise in comfort level desired, depending primarily on the building construction and insulation involved.

Indoor spot heating similarly finds a variety of methods for arriving at the requirements with values generally about 1 to 1½ watts per sq ft for each degree rise in comfort level desired.

For windy conditions (inside or out), design attention to shielding from wind appears more fruitful than building up radiation. Winds of one to three miles per hour increase the required radiation for relative comfort quite materially over that required for still air. For winds of over ten miles per hour, it is questionable whether comfort can be attained with practical radiation densities in ambients lower than 40F. Outdoor applications find real benefit from infrared in mild weather and moderate wind (under ten miles per hour) and for cold weather and little wind (under two miles per hour) but little or no benefit—even after a minimum of 15 to 20 minutes exposure to radiation, in cold windy weather. It is most important that the customer and all others involved are aware of the lowest ambient temperature and accompanying wind or draft conditions under which the system is *expected* to produce comfort.

For complete space heating, infrared heaters are mounted with overlapping heat patterns to cover the entire floor area. Heat is radiated to the floor, occupants, machinery, etc., all of which re-radiate heat to other surfaces which are at lower temperatures. Secondary convection currents transfer some of the heat to the air; however, comfort conditions will be achieved at lower air temperatures than exist with normal convection heating systems. Thus considerable energy is saved in large-volume, high-ceiling spaces since the air need not be heated directly. In such a system, thermal insulation can play an important part in improving comfort and reducing operating costs.

Conventional heat-loss calculations may be made to arrive at the required installed capacity; however, indoor design temperatures may be chosen as low as 50F, depending upon the activity involved. Some extra capacity is usually provided by inclusion of a factor to account for the effect of room configuration on re-radiation from wall and floor surfaces, similar to the use of the room-ratio factor in lighting calculations. In addition, unless the fixtures used provide a well defined concentrated beam of radiation, the spill radiation at greater mounting heights may be relatively ineffective and necessitate the inclusion of extra capacity to account for the mounting height. It is also true that less capacity will be required if a period of preheating is possible before the occupants enter the space, since all surfaces and objects in the room will have had time to absorb radiation. Thus both the mean radiant temperature and air temperature will be greater when the space is finally occupied, inducing greater initial comfort with less direct radiation. Some experience indicates that the installed capacity may be reduced to about 70% calculated value if ½-hr preheating is possible, and to about 50% with 1 hr preheating, where the outside design temperature is 30F and the inside air temperature is 60F.

The heater capacity required for comfort in spot-heating applications depends upon a great many variables. One kilowatt input to an infrared heater will not result in one kilowatt of heat being radiated to the individual to be heated. Involved are such factors as the initial efficiency of the element in converting electrical energy to radiant energy; the amount of the resultant energy which is dissipated by wind or drafts before it can be radiated; how much of what's left will actually impinge on the body of the individual to be heated; the amount of the impinging radiation which is actually absorbed; the extent to which wind or drafts nullify this absorbed radiation; and finally the effect of secondary convection and re-radiation on over-all comfort.

Research indicates that the radiated heat required to be received by the human body for comfort increases from about 60 watts to 350 watts as the mean radiant temperature decreases from 65F to 40F, assuming that there is no wind involved, and that heat is received uniformly and perpendicularly to all body surfaces.

Since low-cost, accurate instruments are not available to measure either the mean radiant temperature or the radiation received by a body, design of spot-heating applications is approached through the input energy to the lamps, using manufacturers' information on the fixture angle of radiation and the element's efficiency of radiation coupled with correct positioning and mounting height of the fixtures to effectively cover the target area.

### LUBRICATION FREQUENCY TABLE

| Type of Bearing | Motor Size Where Normally Applied | Lubrication* Frequency |
|---|---|---|
| Sleeve | | |
| Plain sleeve | Fractional hp | 6 mo to 1 yr |
| Oil-ring sleeve | Large | 6 mo to 1 yr |
| Ball bearing | | |
| Open | Large | 3 mo to 3 yr |
| Single shield | All sizes | 3 mo to 7 yr |
| Double shield | All sizes | 6 mo to 7 yr |
| Sealed | Medium & small | Not needed** |

* Recommended lubrication frequency depends on type of service—easy, standard, severe, or very severe. Use the longest interval on easy applications; use the shortest interval on very severe applications.

**Sealed bearings may be disassembled and repacked with grease at 1 to 5-year intervals depending on kind of service.

# Effective Motor

Here's how a plant electrical department applies modern bearing maintenance techniques to increase the life of motors.

AT THE Weston Instruments Division, Daystrom Inc., Newark, N. J., motors last longer and perform better because plant electricians follow a carefully planned motor lubrication schedule and apply the latest bearing maintenance techniques.

Previously, ac motor failures accounted for a high percentage of electrical repair work. And most of these failures were traced to faulty bearings. As a result, their motor maintenance program places heavy emphasis on proper handling, repair and maintenance of various types of sleeve and ball bearings.

Motors of various types and sizes are used extensively in all processes at the plant, which consists of nine major buildings encompassing 500,000 sq ft. The plant produces a wide range of high-quality electrical measuring instruments as well as instrument component parts. Major processes include plastic molding, small-parts machining, assembly and testing.

In the following personal interview, Howard Wachter, chief electrician, describes his electrical maintenance procedures and discusses modern bearing maintenance techniques.

**How is your electrical department organized?**

The electrical department is part of the maintenance division, which is supervised by the plant engineer. Headed by a chief electrician, the electrical department consists of eight electricians, who perform electrical preventive maintenance as well as emergency breakdown repairs.

The chief electrician plans electrical preventive maintenance, supervises the electrical crew, formulates electrical maintenance and repair procedures, selects spare electrical parts, and advises on selection of new electrical equipment.

**How is your EPM (electrical preventive maintenance) program set up?**

We do not go overboard on preventive maintenance. Because we are essentially an assembly plant and because our products are, in a sense, handmade or custom-made, our processes do not include a high-production continuous type of operation. Related to electrical maintenance, this means that downtime will not hurt us nearly as much as it hurts an automated high-production process. Therefore, we feel it is more efficient to function with a minimum-size electrical crew and perform electrical maintenance on only essential or expensive equipment or where it is needed.

However, since motor failures

Seventh in a series of articles on current industrial electrical maintenance. Previous studies were: (1) Effective Large Plant Maintenance, April, 1961; (2) Effective Small Plant Maintenance, June, 1961; (3) Electrical Maintenance by Contract, August, 1961; (4) Effective Maintenance Starts at the Top, October, 1961; (5) New Plant Start-Up, January, 1962; (6) Tools and Techniques for Effective Maintenance, March, 1962. This series covers operating procedures and work methods in typical industrial plants through personal interviews with key plant personnel.

**BALL BEARING** is assembled into cartridge-type housing. Bearing must be seated squarely on shaft and must fit snugly. Before installing on shaft, bearing should be heated either by an induction heating unit, or by immersing it in oil that has been heated to a temperature of about 200°F.

**VERTICAL INSERTION** aids in centering motor shaft to housing when extreme clearances occur. The bearing should be free to move axially to allow for shaft expansion. If the fit is too loose, however, the housing will be damaged. During all assembly phases, strict cleanliness must be maintained.

**PLAIN SLEEVE BEARING** receives a coating of a durable plastic sealant, which acts as a shim, filling excess clearance between bearing and housing. After the application, the assembly is set aside for two to four hours to allow the sealant to harden into a strong and long-wearing surface.

# Bearing Maintenance

were our most frequent cause of downtime, we felt that preventive maintenance or other necessary steps to reduce motor failures would be worthwhile. Therefore, we investigated these motor breakdowns and, as a result, we established a modern motor repair and maintenance program.

**How was your motor maintenance program established?**

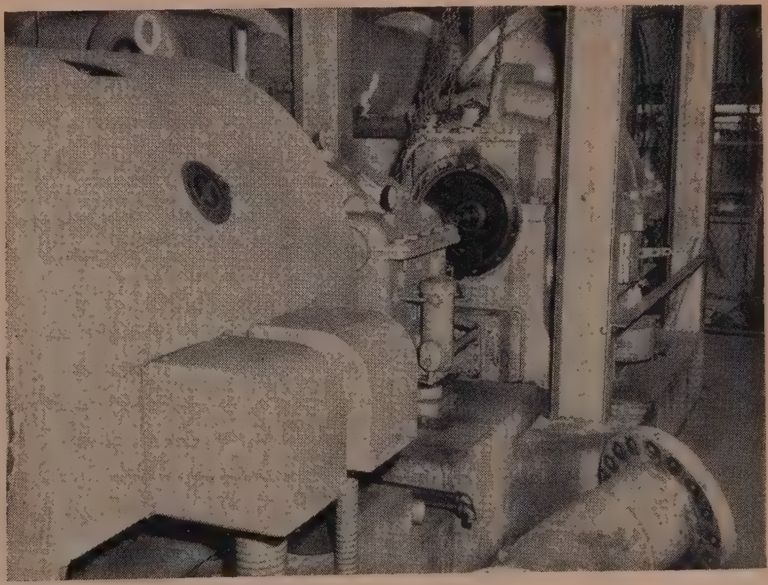
The first step was to find out why our ac motors were failing. And, of course, there are various causes of motor breakdowns, such as excessive load, binding or misalignment of motor drives, wet or dirty surroundings and bearing failures. Among these we found that faulty motor bearings were the most common cause of failure. And it is significant that such failures occurred in newer motors with high-quality bearings as frequently as in older motors equipped with less reliable bearings. A notable exception was that motors equipped with sealed bearings were much less prone to failure.

Considering this data, particularly the fact that sealed bearings are shielded from contamination and do not require lubrication, we concluded that contamination of bearings was one of the major causes of bearing failures.

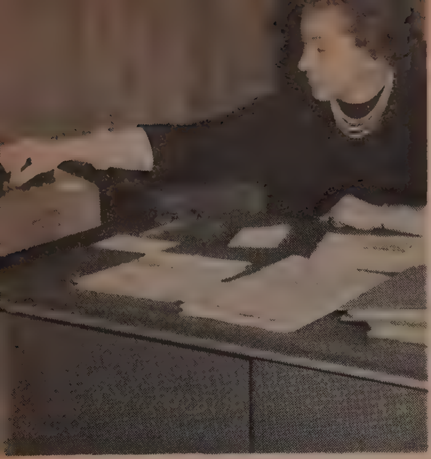
As a result, we updated our motor lubrication methods and bearing maintenance techniques, emphasizing cleanliness in procedures for all types of motor bearings.

**What types of bearings must you maintain?**

There are many types of bearings, however, most of our motors are equipped with ball bearings. Ball bearings may be found on various-size motors and their construction may be (1) open, (2) single shielded, (3) double shielded, (4) sealed, plus double row and other special types. Open bearings are of open construction and must be installed in a sealed housing. These bearings are less apt to cause churning of grease, hence they are usually applied only on large motors.



**BEARING MAINTENANCE** includes overhaul and inspection of large oil-ring sleeve bearings. At left of photo, a 4160-volt, 250-hp wound-rotor motor drives a refrigerant compressor via a speed converter. Exposed coupling at the compressor will be checked for alignment.



**ELECTRONIC CODED-PAGING** system incorporates an encoder, transmitter and several small, pocket size receivers which are worn by maintenance foreman. Maintenance secretary can dial a foreman's code on encoder, operate a switch and thus immediately contact the foreman anywhere in or near the plant.

**POCKET-SIZE RECEIVER** is worn at the belt by chief electrician, Howard Wachter. Upon receiving the proper signal from the transmitter, the receiver emits a series of "beeps" that correspond to Mr. Wachter's code. He then calls in to receive his message. The electronic paging system has proved to be an efficient time-saver.

The single-shielded bearing has a shield on one side to preclude grease from the motor windings. Double-shielded bearings have a shield on both sides of the bearing. This type of bearing is less susceptible to contamination and, because of its design, reduces the possibility of overgreasing. Sealed bearings have, on each side of the bearing, double shields which form an excellent seal. This bearing requires no maintenance, affords protection from contamination at all times, and does not require regreasing. It is usually used on small or medium-size motors.

Our very large motors are furnished with oil-ring sleeve bearings. And some of our fractional-hp motors are equipped with plain sleeve bearings.

**How often do you lubricate motor bearings?**

Frequency of motor lubrication depends not only on the type of bearing but also on the motor application.

Small and medium-size motors equipped with ball bearings (except sealed bearings) are greased every three to six years if the motor duty is normal. On severe applications (high temperature, wet or dirty location, or corrosive atmosphere), lubrication may be required more often. In severe applications, past experience and condition of the grease are the best guides as to frequency of lubrication.

We change lubrication oil in sleeve bearings at least once a year. When the motor duty is severe or the oil appears dirty, we change it sooner.

**Describe your motor lubrication procedure.**

For effective motor lubrication, cleanliness and use of the proper lubricant are of paramount importance.

When greasing a ball-bearing motor, the bearing housing, grease gun and fittings are wiped clean. Great care must be taken to keep dirt out of the bearing when greasing. Next, the relief plug is removed from the bottom of the bearing housing. This is done to prevent excessive pressure from building up inside the bearing housing during greasing. Grease is then added, with the motor running if possible, until it begins to flow from the relief hole. Allow the motor to run from 5 to 10 minutes to expell excess grease. Then the relief plug is replaced and the bearing housing is cleaned.

It is important to avoid overgreasing. When too much grease is forced into a bearing, a churning of the lubricant occurs, resulting in high temperature and eventual bearing failure.

On motors that do not have a relief hole, we apply grease sparingly. If possible we disassemble the motor and repack the bearing housing with the proper amount of grease. During this procedure we always maintain strict cleanliness.

The importance of strict adherence to these procedures cannot be overemphasized. We feel that *contamination* and *overgreasing* of bearings are the major causes of bearing failures.

For sleeve bearings, we use only the recommended oil for particular service conditions. Observing careful cleanliness, old oil is removed and new oil is added until the oil level reaches the "full" line on the oil sight gauge. This is done only when the motor is not running.

**How do you test or check the condition of bearings on motors in place?**

We find that the two most effective tests are what you might call the "feel" test and the "sound" test. The "feel" test is performed by the electrician. If, while the motor is running, the bearing housing feels overly hot to touch, it is probably malfunctioning. (Some bearings, however, may operate safely up to about 85° C.)

During the "sound" test, the electrician listens for foreign noises coming from the motor. Also, he may place one end of steel rod—3 ft long and about $\frac{1}{2}$ in. in diameter—on the bearing housing; the other end is held against his ear. The rod then acts as an amplifier, transmitting unusual sounds such as thumping or grinding, which would indicate a failing bearing. Special listening devices, such as the transistorized stethoscope, can also be used for this purpose.

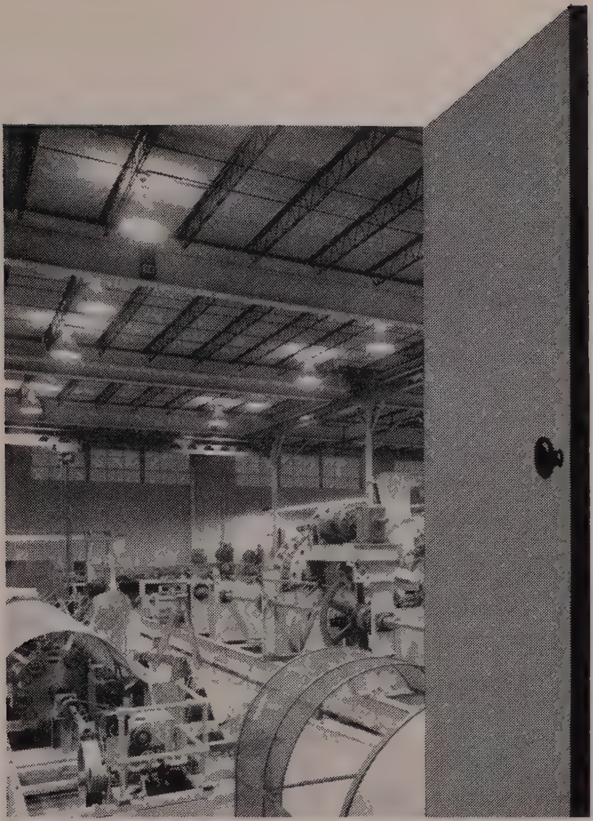
Additional checks can be made. For example, the air gap on sleeve-bearing motors should be checked periodically. These tests, performed with a feeler gauge, indicate when a bearing begins to wear. Four measurements are taken about 90 degrees apart around the rotor periphery. These measurements are recorded and compared with earlier readings, providing a check on condition of the bearing.

Motors should also be checked for end play. Ball-bearing motors should have about $\frac{1}{32}$ in. to $\frac{1}{16}$ in. end play. Sleeve-bearing motors may have up to $\frac{1}{2}$ in. end play.

On large sleeve bearings the oil level is checked periodically, and the oil is visually inspected for contamination. If it is possible, the electrician checks that the oil rings rotate when the motor is operating.

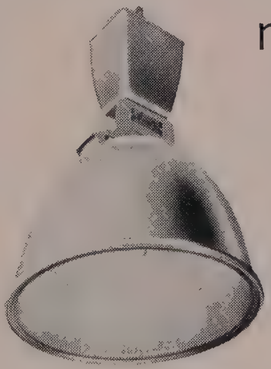
Other inspections include checking for misaligned or bent shafts and for excessive belt pressure.

(Continued on page 170)



# SOLA OPENS THE DOOR TO ECONOMICAL INDOOR MERCURY LIGHTING!

The new Sola Merc-Mite line introduces the constant-wattage ballast of the future. Size: 50% less than conventional models! Price: about 25% lower than today's premium units. Sola Merc-Mite ballasts leave old ideas so far behind that their unique combination of performance, size and economy prompted the Holophane Company to specify them for their new line of Prismpack luminaires (see photo). Also can be supplied to you for outdoor lighting systems. For more information on the new Merc-Mite CW ballast, write Sola direct.

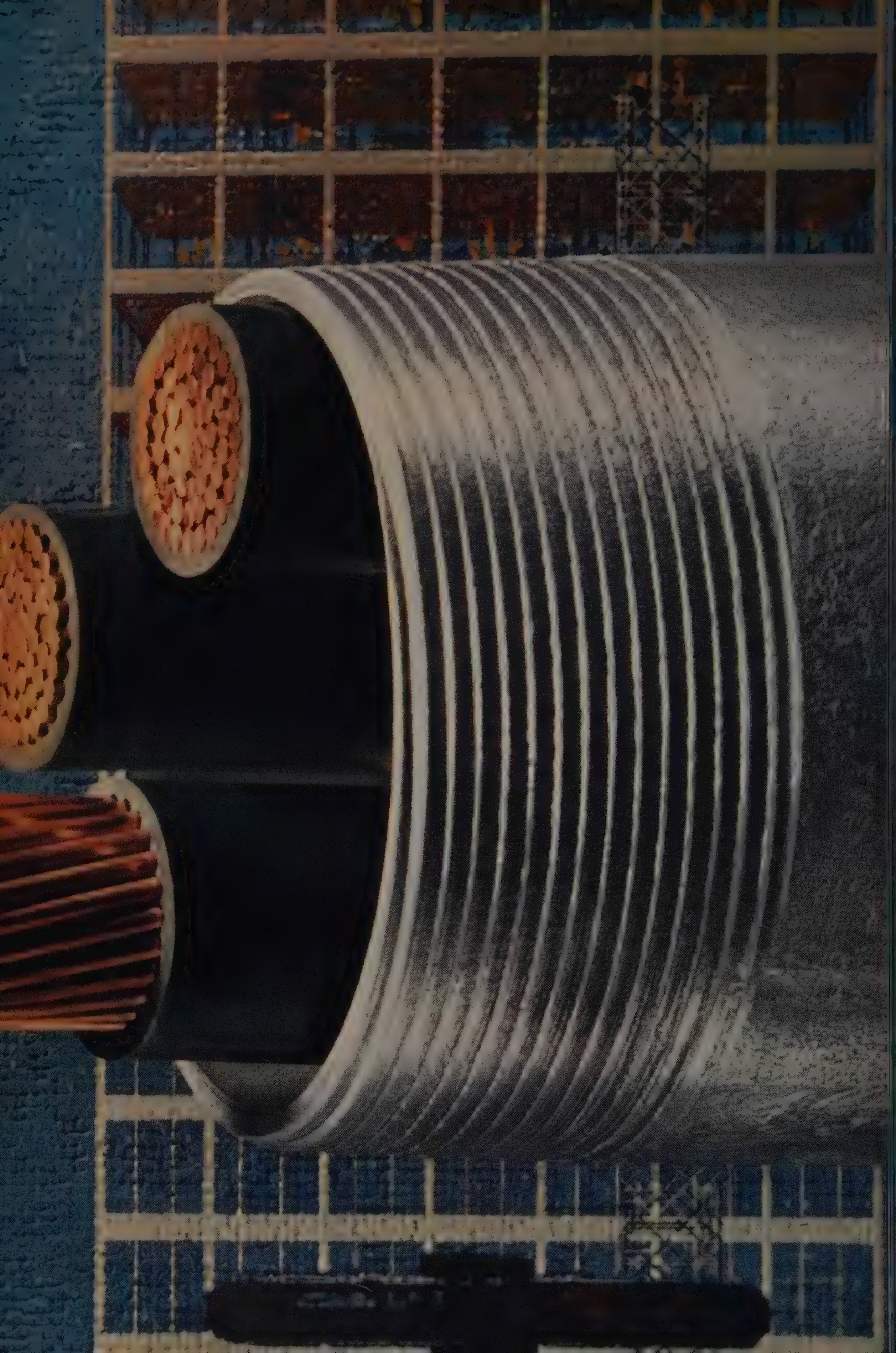


**SOLA**
A DIVISION OF
B P
C

1717 Busse Rd., Elk Grove Village, Ill.
HEmpstead 9-2800
IN CANADA, Sola-Basic Products Ltd.,
377 Evans Ave., Toronto 18, Ontario

**BASIC PRODUCTS CORPORATION**

S-3-63



# THREADS

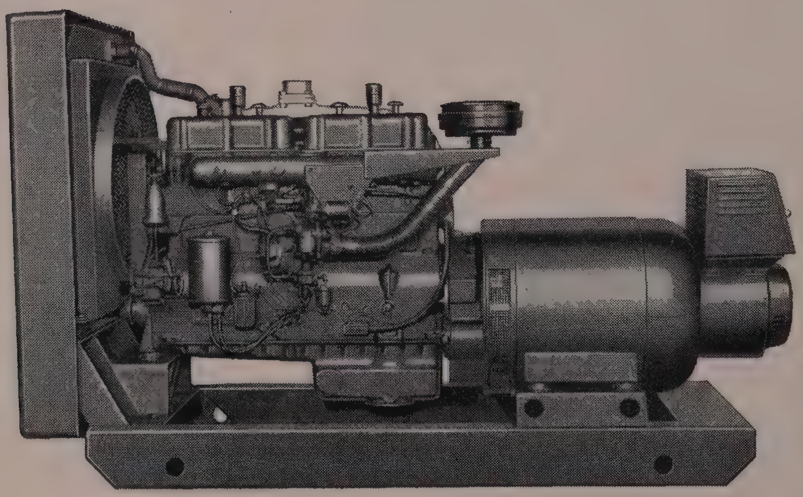
Zinc-coated threads protect your steel electrical raceway job years after installation. Every piece of Youngstown rigid steel conduit features hot dipped galvanized threads. Result: elimination of corrosion from moisture forming in the fittings. Youngstown is superior conduit with a controlled zinc coating throughout. Cut it easier. Bend, thread, install it faster. Fishing and wire-pulling are easier. Count on Youngstown steel conduit for good continuity of ground, better heat and fire resistance. Get it with hot galvanized threads in sizes ½″ through 6″ from your electrical distributor. Buckeye for standard jobs, exclusive Yoloy where corrosion is a problem. You buy from the world's largest producer when you order dependable steel conduit from Youngstown, growing force in steel.

**Youngstown Steel**

THE YOUNGSTOWN SHEET AND TUBE COMPANY

For information about Youngstown Steel Conduit write: Dept. 26A
THE YOUNGSTOWN SHEET AND TUBE COMPANY, YOUNGSTOWN, OHI

# is STAND-BY a big enough word in your POWER PLANNING?



## FOR INDUSTRY

Production lines, data processing equipment, office machines, lights and procedures of various types and kinds depend on electricity for power. Every additional piece of such equipment demands more power and requires additional stand-by power to meet vital emergency needs. Are your stand-by recommendations adequate?

## FOR BUSINESS

Extra elevator, escalator facilities, improved lighting systems, added bookkeeping equipment, inter-office communications systems, air conditioning all call for extra power, more wattage. Can present stand-by plants supply full power for every new facility installed?

## FOR HOSPITALS

Only thirty-five per cent of all hospitals have sufficient stand-by power to meet every emergency in every part of a hospital. New wards, extra equipment, modernization programs call for more and more power. Can every patient be provided with all of the essential services when power failure hits?

## FOR BANKING

Power bookkeeping has made stand-by power more necessary than ever. Check sorters, computers, market ticker-tapes are constantly increasing the dependency on electric power. How much would a sixty-minute power failure cost your client?

**KOHLER OF KOHLER**

Kohler Co., Established 1873 • Kohler, Wisconsin

ENAMELED IRON AND VITREOUS CHINA PLUMBING FIXTURES • ALL-BRASS FITTINGS • ELECTRIC PLANTS • AIR-COOLED ENGINES • PRECISION CONTROLS

## All-Electric Concept For Refrigerated Warehouse

Associated Foods recently constructed a huge central warehouse in Salt Lake City, designed for temporary storage of perishable foods sold through 250 shopping outlets in Utah and Nevada. In effect, the structure is a giant refrigerator where in some areas temperatures as low as minus 8° F are maintained to preserve frozen produce.

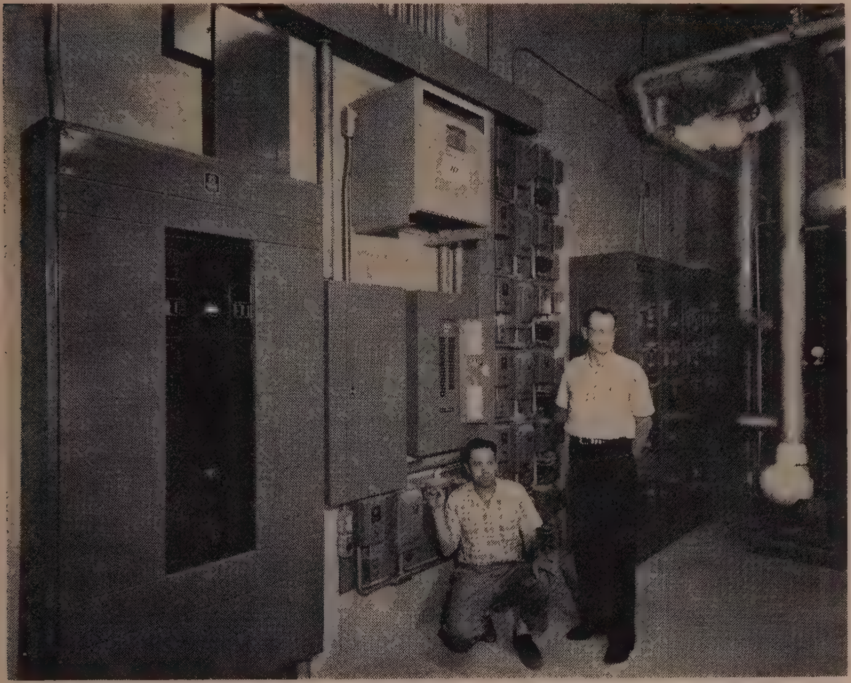
The building, however, does not limit its all-electric approach to just refrigeration, since heating of office space is accomplished by heat pump; drain pipes are prevented from freezing by wrapping them with heating cables; lighting combines several contrasting treatments, while the handling of goods is accomplished by means of several battery-operated fork trucks.

As defined by electrical contractor Irwin Thompson, the 55,000-sq-ft building is "nothing but" electrical; clean, since no fumes or dirt relate to conventional heating methods; having maximum usable floor space, because electrical equipment is compact and generally mounted overhead; conveniently operated, because controls are governed automatically by thermostats and time switches; and easily maintained, because air intake is filtered to exclude dust; and equipment is located to permit ready accessibility.

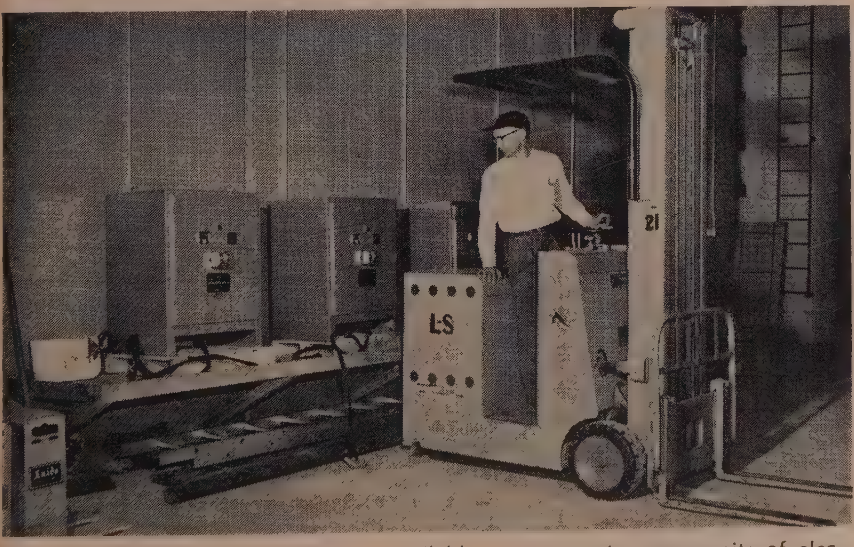
In this modern food storage depot lighting varies from—offices, where 100 footcandles of comfortable illumination is obtained by recessed troffers—to frozen food rooms, where jacketed T-10-J fluorescent lamps are installed in open-type fixtures. Areas subjected to high humidity contain vaporproof fluorescent luminaires that provide 50 fc

Lighting in these several areas is served from 277-volt circuits, although low-voltage switching is used for remote control. Where 110-volt service is required for office machines and similar purposes, local dry-type transformers are installed to power the receptacle outlets. And, to recharge batteries of fork-lift materials-handling trucks, automatic rectifier units are available for nightly regeneration.

It is interesting to note that the decision to go all-electric was prompted primarily by economy. Consulting electrical engineer Vernon Proctor; consulting mechani-

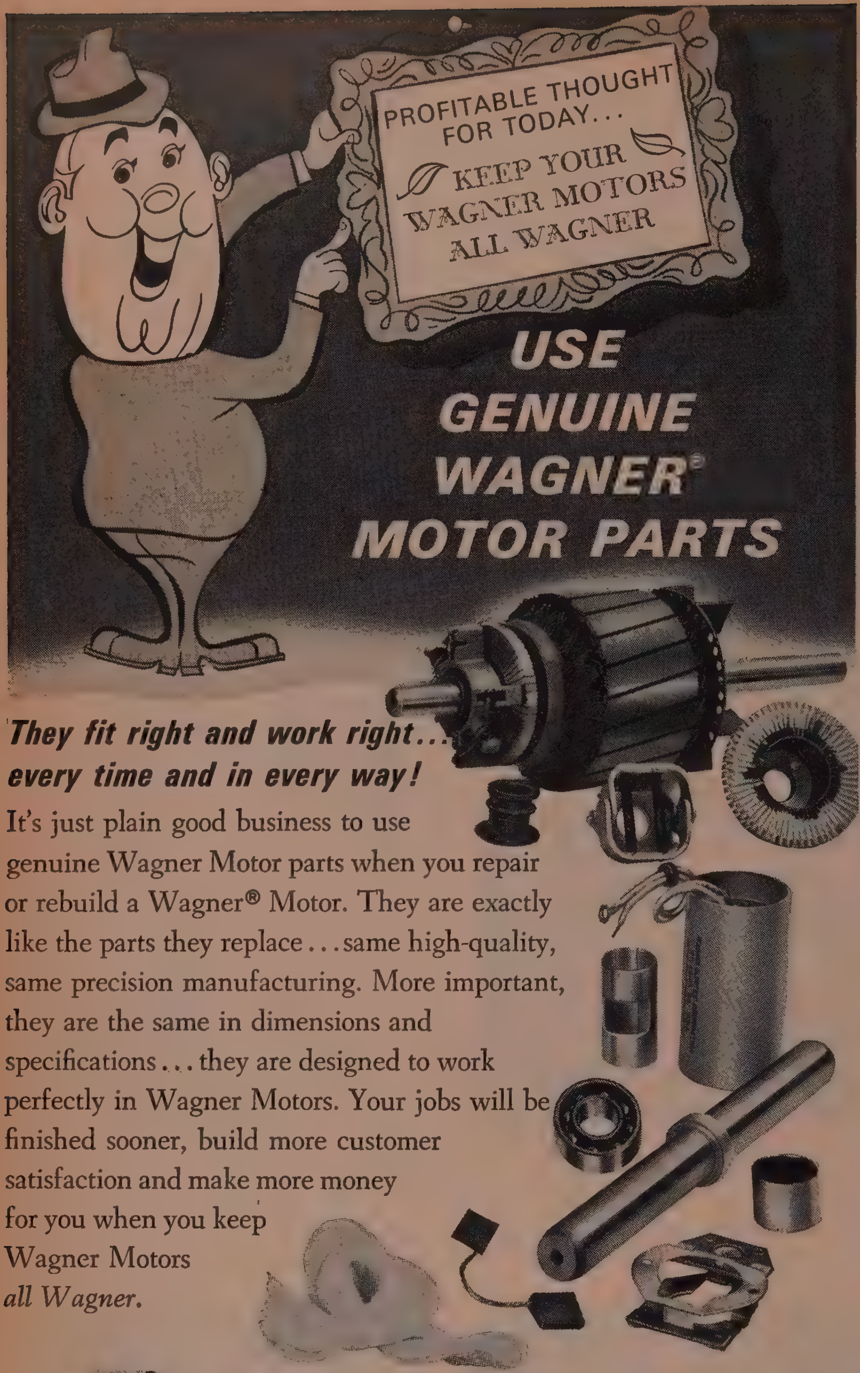


**SWITCHGEAR CONCENTRATION** includes main breakers at left, 480/277-volt distribution panels, wall-mounted lightweight low-decibel intermediate transformer, 120-volt branch-circuit control, motor control center related to warehouse refrigeration and frozen food rooms. Check-out upon job completion was made by electrical contractor Irwin Thompson, standing, and foreman John Yates.



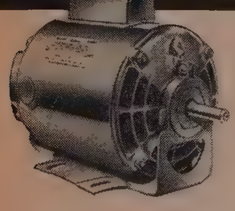
**THREE RECTIFIER CHARGERS** are available to regenerate power units of electric fork trucks used to shift and lift cases of foodstuffs in storage depot. Nightly charge permits trucks to operate constantly for 8 hours the following day.

**BELOW ZERO** temperatures are obtained in frozen food rooms by means of ceiling-suspended refrigeration units, while incorporated electric heaters are used for daily defrosting. Jacketed T-10-J fluorescent lamps placed in open fixtures provide 35 footcandles of illumination in these areas.


PROFITABLE THOUGHT FOR TODAY...
KEEP YOUR WAGNER MOTORS ALL WAGNER
USE GENUINE WAGNER® MOTOR PARTS

***They fit right and work right... every time and in every way!***

It's just plain good business to use genuine Wagner Motor parts when you repair or rebuild a Wagner® Motor. They are exactly like the parts they replace... same high-quality, same precision manufacturing. More important, they are the same in dimensions and specifications... they are designed to work perfectly in Wagner Motors. Your jobs will be finished sooner, build more customer satisfaction and make more money for you when you keep Wagner Motors *all Wagner.*



***IF THE MOTOR ISN'T WORTH REPAIRING, SELL A NEW WAGNER MOTOR!*** There are times when it just doesn't pay to repair a motor. It isn't profitable for you. *That's the time to sell a new Wagner Motor as replacement.* You will get full profit and the customer will have confidence in both you and the motor. Your Wagner distributor has all the details along with special sales aids. Ask him how you can cash in on new Wagner Motor sales.

**Wagner Electric Corporation**
6413 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.
Manufacturers of LOCKHEED® Products
OVER 850 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS
WR62-2
MOTORS • BEARINGS • STANDARD ROTORS • BRUSHES • CAPACITORS • COMMUTATORS

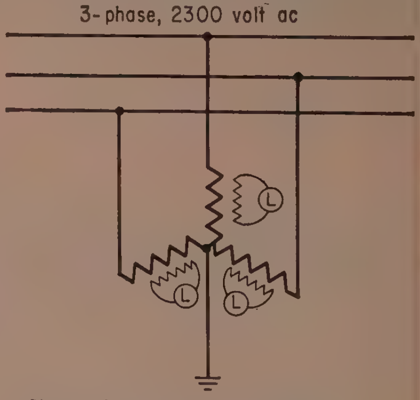
cal engineer Richard C. Brown; architect James C. Richie, Snedaker, Budd, Monroe and Associates, plus executives of Associated Foods were in complete agreement that an all-electric installation would provide the most economical overall answer to their combined heating-cooling-lighting-power needs. And, after a year of comparing installation and operating charges with similar installations of comparative size and purpose, this economic pre-conclusion has been verified by "cold facts."

## Ground Detection on High-Voltage Feed

The following is a report from Lindsey Hoben, Oak Ridge, Tenn., describing use of a special hookup of potential transformers and signal lamps to warn against incipient ground faults on primary feeder circuits:

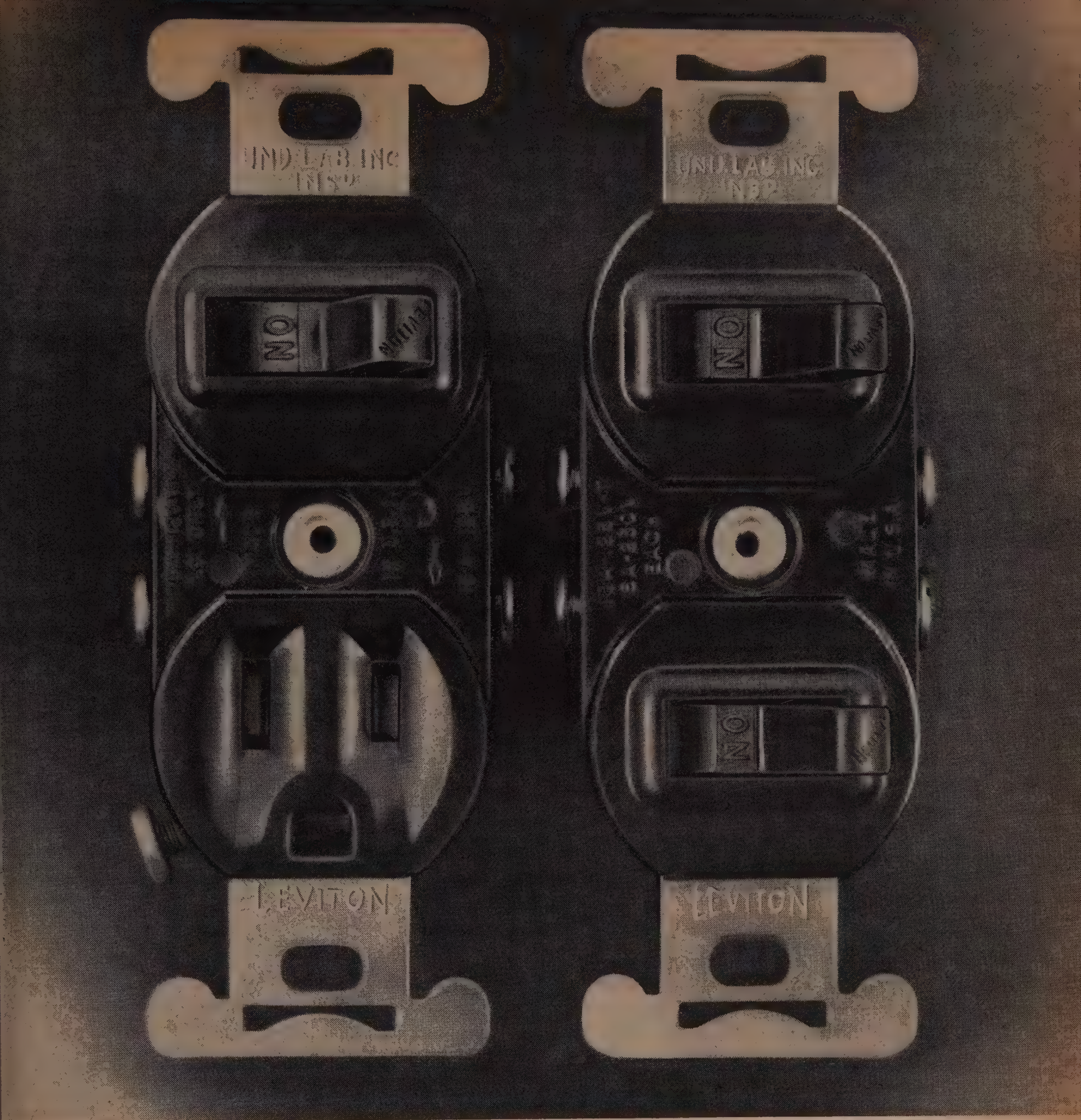
Electrically powered shovels and dewatering pumps operating in our coal strip mine are powered through trailing cables extending from skid-mounted transformer and switch-breaker cabinets. Since grounds of any type are undesired afflictions in this work, we had need for a warning device that could be readily assembled and maintained at a minimum cost.

The accompanying sketch shows how three potential-type transformers are utilized to furnish the low-voltage current by a wye connection. With everything shipshape and free of grounds the line voltage is 2400 volts while that of the secondary is 64 volts for the lamp supply. As a ground develops the lamp powered by the potential transformer hooked to that phase dims gradually, or darkens com-



Circuit of potential transformers coupled to three 5-watt, 120-v lamps.

Lamps burn on 64 volts with lines free of ground. One leg grounded brightens two lamps to full 120-volt brilliance.



# TIME TESTED

Forty years ago we introduced the first line of combination devices. Forty years later these tested, proven, universally accepted products are being specified in major installations across the country. There must be a reason. Maybe it's the scope of the line . . . more combinations to choose from than any other source—(the most complete line of AC Quiet Switches in the industry is included). Maybe it's the quality . . . sales in millions, returns and complaints practically nil. Maybe it's our research . . . a never-ending quest for newer, better ways to meet your every requirement. Whatever the reason (and we strongly suspect it's a combination of all three) Leviton Combination Devices bring you the assurance of quality and performance. ■ Our completely new illustrated brochure on the entire line belongs in your files. May we suggest you write to Dept. EC2 today? **Leviton Manufacturing Co., Inc., Brooklyn 22, New York.**

**LEVITON®**

THE MAXIMUM PERFORMANCE PRODUCT

NOW — CARRY JUST ONE DRILL ON ALL YOUR JOBS!

NEW STANLEY ALL-PURPOSE ½" DRILL

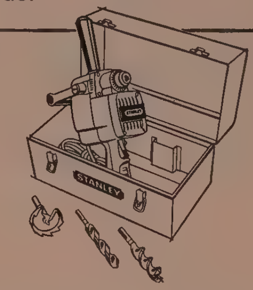
combines the functions of both straight and right angle drills in one compact unit!

As short as 5¾" from chuck end to rear of gear housing and only 3⅜" wide, the new Stanley All-Purpose ½" Drill gets easily into recessed areas and other hard-to-reach spots. Compact as a ¼" drill, it provides the speed, power and torque you need for fast drilling in tough materials.

For even greater versatility, the Stanley All-Purpose Drill has 3 handles: a non-removable switch handle; a removable spade handle; and a die-cast auxiliary handle that can be mounted on the top, the right side or the left side . . . providing the right set-up for any job. Designed to take heavy-duty operation in stride..

AVAILABLE IN HANDY KIT

The Stanley All-Purpose ½" Reversing Drill (No. 723) is available in this handy "Artisan's Kit." Designed specifically to meet your needs, this kit includes: All-Purpose Drill (220 R.P.M. Full Load-Reversing) ¾" electrician's bit, ⅛" auger bit, 2-9/16" self feed bit, and sturdy metal carrying case.



OTHER MODELS: No. H722, ½", 300 R.P.M.; No. 724, ½", 550 R.P.M.; No. 725, ½", 250 R.P.M. All R.P.M.'s are full load.

FOR COMPLETE INFORMATION . . . see your Stanley Supplier or write direct.

STANLEY POWER TOOLS

STANLEY®

DIVISION OF THE STANLEY WORKS
878 MYRTLE STREET
NEW BRITAIN, CONNECTICUT

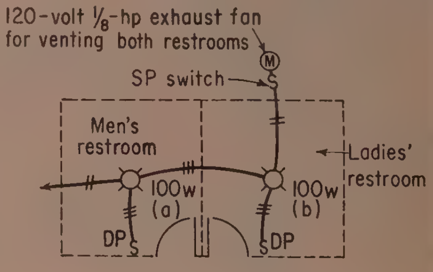
pletely, depending on the resistance to earth of the ground leg. Should the ground be "dead short," the remaining lamps brighten to the full 120-volt value since the transformers are now at peak voltage.

The lamps are mounted behind crystal bezels, mounted in the metal panel so that rays are thus intensified and can be more readily read from quite some distance. With phase designations stenciled over each bezel there is no confusion as to the location of trouble. Where an uninterrupted view is not readily maintained, the sight signal can be augmented by the use of relay arranged to sound a horn or bell as a direct ground develops.

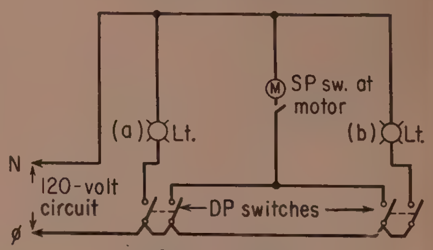
Troubleshooting is not attempted until lunch periods or shift-change time, to keep production rolling uninterrupted as long as possible.

## DP Switches Solve Wiring Problem

On one of his wiring jobs, Frank Hotchkiss, an electrical contractor of Patchogue, N. Y., had the problem of providing control of a light in each of two rest rooms plus providing continuous operation of a single exhaust fan (which vents both rest rooms) when either or both lights were on. Job specifications stated that the flush wall switch in each rest room could control only the light in that room;

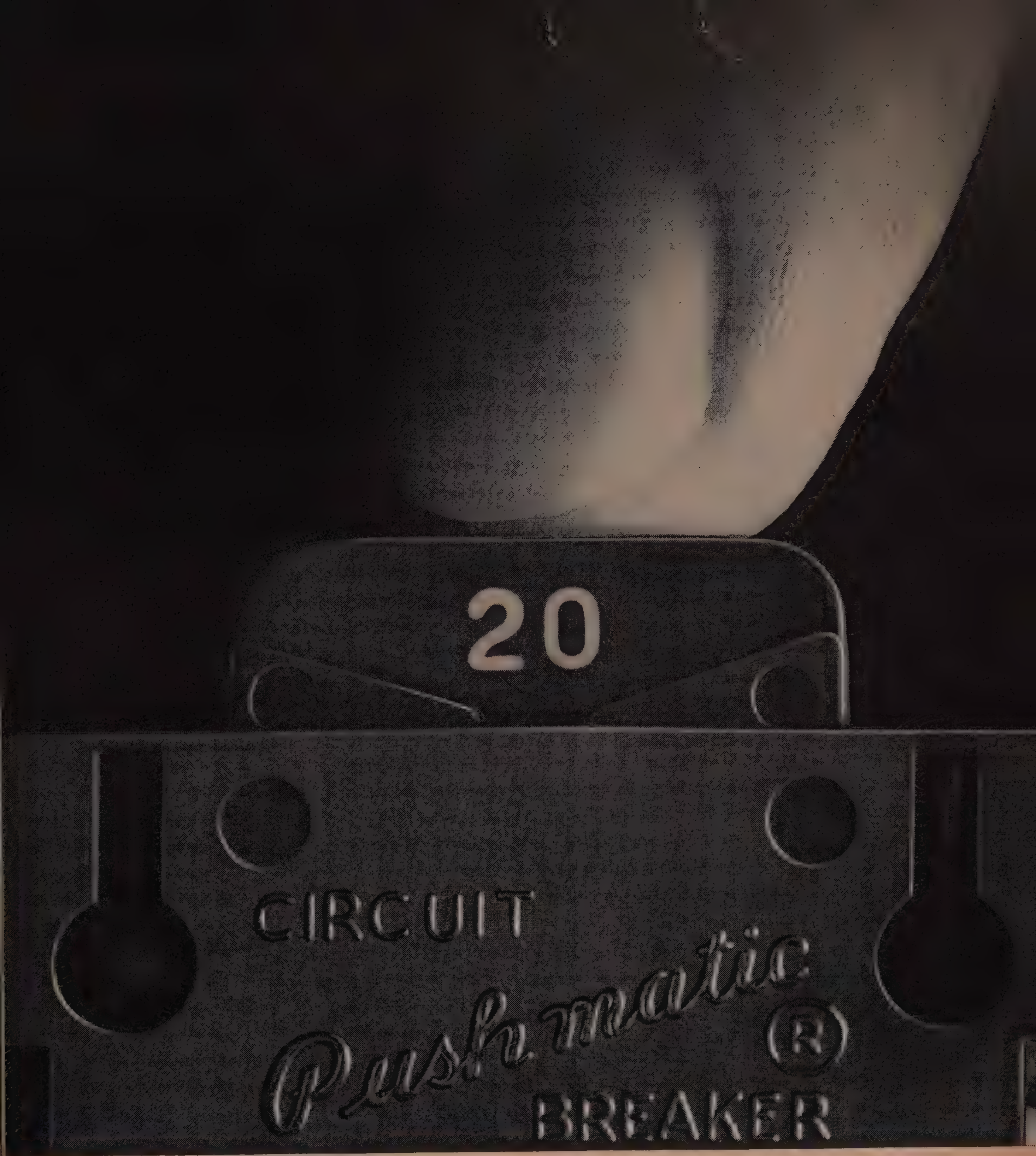


LINE DIAGRAM



WIRING DIAGRAM

**TWO DP SWITCHES** permit the control of individual lights, while starting a single exhaust fan when either switch is in the ON position. The fan is disconnected only if both DP switches are in the OFF position. Installed at the fan, a SP switch provides a disconnecting means when it is necessary to service the fan motor or related equipment.



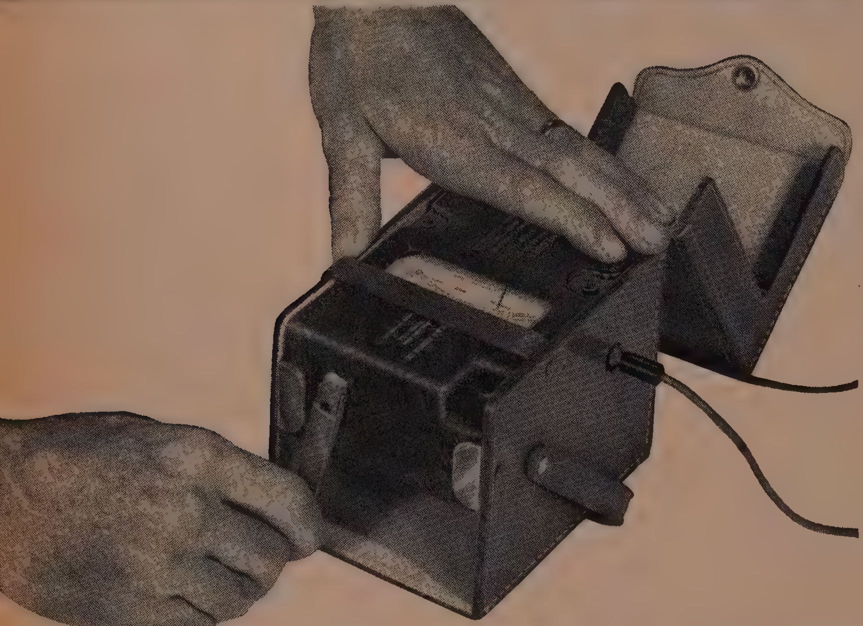
Write for your copy of
"The Story Behind the Ad".

**PUSHBUTTON CONVENIENCE**... IN A PUSHBUTTON WORLD. A MODERN EXCLUSIVE WITH ALL BULLDOG PUSHMATIC® CIRCUIT BREAKERS. BUY OPERATING CONVENIENCE, TOO. BUY PUSHMATIC. CONTACT YOUR I-T-E DISTRIBUTOR OR YOUR LOCAL I-T-E SALES OFFICE TODAY.

**I-T-E CIRCUIT BREAKER COMPANY**
**BULLDOG ELECTRIC PRODUCTS DIVISION**
BOX 177 • DETROIT 32, MICHIGAN

In Canada: 80 Clayson Rd., Toronto, Weston, Ont.

NEW MARK III
MEGGER® INSULATION TESTER



COMBINES POPULAR MIDGET MEGGER FEATURES WITH IMPORTANT NEW IMPROVEMENTS:

CONSTANT TESTING VOLTAGE • MEGOHM AND OHM SCALES

Compact, completely self-contained Mark III instruments require no atteries or other power supply. Built-in hand-driven generator with olding crank provides constant testing voltage for circuits with capaciance of up to 4 microfarads. Specially designed ohmmeter measures value f insulation resistance directly in megohms; double scale instruments *ncluding* ohm scale also available on all models. Leads store in handy amera type case, plug into spring plunger type terminals for use. Ideal or detecting faulty insulation on motors, generators, rotary converters, ransformers, power cables nd wiring, lighting ciruits, control equipment nd wiring. Available in hree models for a wide ange of testing applications.

| Voltage | Range |
|---|---|
| 100 volt | 0.02-20 megohms |
| 250 volt | 0.05-50 megohms |
| 500 volt | 0.1 -100 megohms |

All models available with 0-10,000 ohm scale

he new, improved Mark III is the *practical* answer to the need for test ccuracy and dependability at low instrument cost. Write for Bulletin 1-85-ECM.

B-123

JAMES G. BIDDLE CO.
Electrical & Speed Measuring Instruments
1316 ARCH STREET • PHILADELPHIA 7, PA.

and at the same time, the closing of either switch had to start the exhaust fan. After both switches were turned off, it was a requirement that the fan shut off.

This unusual arrangement stems from building code rules that require the simultaneous operation of an exhaust fan and light by a single switch in inside bathrooms requiring mechanical ventilation. However, in the job in question, the architect chose to vent two rest rooms through a single exhaust fan, thereby eliminating the cost of an extra unit.

Hotchkiss solved the problem by using a double-pole, 15-amp, ac rated snap switch in each rest room. At each switch, one pole controlled its respective light, while the load sides of the second poles in both switches were tied together and formed a common connection to the fan motor. All poles on the line side of both DP switches were paralleled to the ungrounded branch-circuit conductor, and the neutral conductor fed one side of each light and the fan. Since both switches had to be in the OFF position to disconnect the motor, a SP switch was installed at the motor so that it could be safely serviced. As an added safety feature, the motor contains an inherent overload protective device that disconnects the motor if it stalls or is overloaded. Wiring connections are shown in an accompanying sketch.

## Epoxy Resin Waterproofs Splices Outdoors

Waterproofing outdoor control-cable splices can often be troublesome and difficult. But a new and simplified technique developed by C & S Products Co., using epoxy resin, was recently applied with excellent results.

The problem of waterproofing outside multi-conductor cable arose during construction of the US Navy VLF (very low frequency) radio station at Cutler, Me. This 70-million dollar installation includes generators providing over two million watts of power, 1000-ft. high antenna arrays, and 200,000 ft of multi-purpose cable. Much of the multi-conductor cable is installed in ductlines and manholes, therefore the problem of protecting multi-conductor splices from seepage water was of paramount importance.

# I-T-E CIRCUIT BREAKER LOADCENTERS

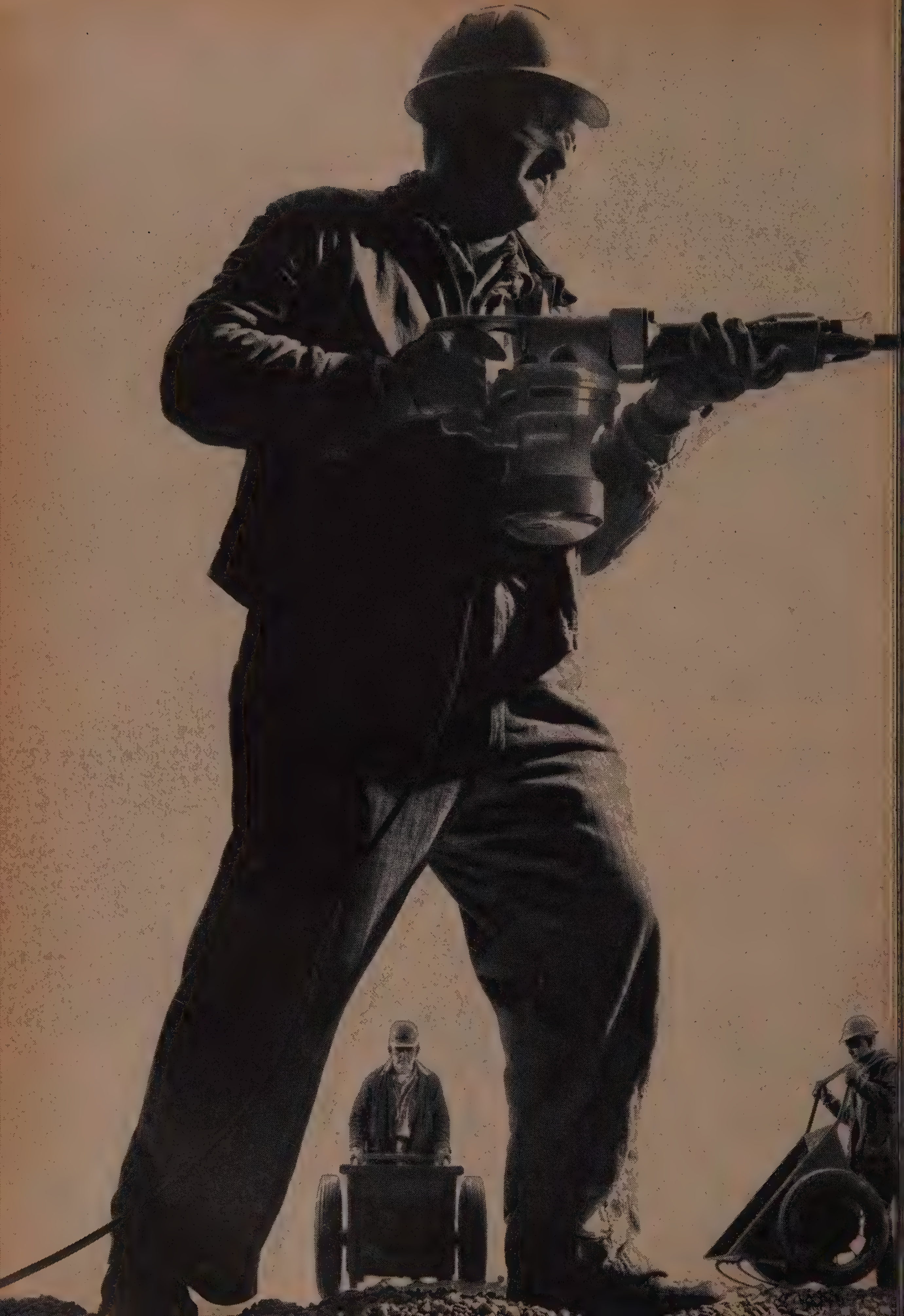
*Specify I-T-E! Panelboard-type construction assures commercial quality in a residential product!* And, separate Uni-Pak packaging speeds installation. First, you mount the 14¼″ Uni-Pak box snugly between 16″ stud centers . . . *hang* either fusible or breaker interior as you would a picture . . . *add trim* and job's done! You do not tie-up working capital if you buy the box, interior and trim separately to install separately. *Write to I-T-E CIRCUIT BREAKER COMPANY, WALKER DIVISION, 125 Bennett Street, N. W., Atlanta 9, Georgia. Ask for the SPEEDFAX CATALOG.*

TRIM is flush-to-wall.

## for the contractor who is proud of his work!

**I-T-E CIRCUIT BREAKER COMPANY**

WALKER DIVISION



# WHY DID WE NAME IT SUPER HAMMER?

THE NEW BLACK & DECKER SUPER HAMMER WORKS HARDER, LIVES LONGER. SO TOUGH, WE BACK IT WITH A YEAR'S FREE SERVICE CERTIFICATE!

It makes any man ten feet tall and tough! The harder the job, the more this new Black & Decker Electric Super Hammer eats it up. What's so "super" about this new tool? It starts with extra-heavy-duty construction and ends with power-packed performance. It'll bust through, knock down or chip up any demolition job *faster* . . . and live longer doing it. We have so much faith in the toughness of this tool, we pack a certificate for a FREE YEAR'S SERVICE with every Super Hammer.

Internally, this hammer utilizes controlled air pressure to produce consistent, heavy blows. On-the-job tests have proved it will do more work than any other electric hammer on the market. But don't take our word for it . . . try it yourself. We'll be glad to arrange a free demonstration. You'll find Super Hammers at leading distributors everywhere. *For sales or service, look in the Yellow Pages under . . .* TOOLS ELECTRIC

**Black & Decker**®

MAKER OF THE WORLD'S FIRST
CORDLESS ELECTRIC TOOLS

The Black & Decker Mfg. Co., Dept. 1208
Towson 4, Md. (In Canada: Brockville, Ont.)

☐ Please arrange for a demonstration of the new Super Hammer.

☐ Please send me more information about the Super Hammer.

Name________________Title________

Company________________________

Address________________________

City__________Zone____State________

EXIDE-MANCHEX
EXIDE-TYTEX (Silvium* or calcium grids)
EXIDE-IRONCLAD
EXIDE NICKEL CADMIUM (pocket positive)
Exide
Exide
Exide

# Smart way to choose a battery—decide which advantage you need most: low cost, long life, small space, easy maintenance. Then pick from these four Exide types.

One of these Exide batteries fits in a smaller space than any of the others for a given capacity. One costs less. One gives the longest life. One costs the least to maintain. Each is the smartest buy for certain applications. One is the smartest buy for you. Only Exide offers so broad a line of stationary batteries. So your Exide sales engineer can give you honest counsel on their comparative advantages. Ask him to make an engineering study of your battery requirements. For literature on these batteries, write Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

**EXIDE POWER PACKAGE**

Your assurance of most dependable and economical battery power. It includes the battery you should have, a charger to match, and the service you need (provided by factory-trained industrial battery specialists), all backed by Exide. It's the complete package you can buy with confidence.

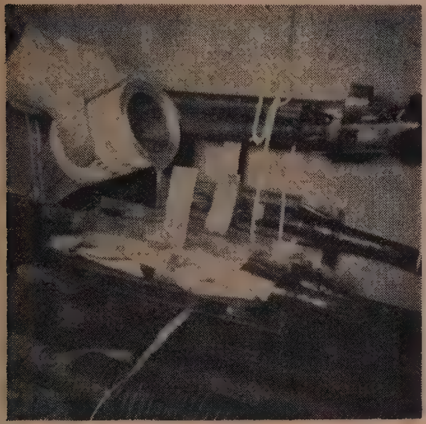
*Exide's patented corrosion-resistant grid alloy

**Exide®**

**INDUSTRIAL MARKETING DIVISION**
The Electric Storage Battery Company
ESB

**MULTI-CONDUCTOR SPLICES,** when installed in wet locations, require positive waterproofing. Shown are a 26-pair cable and a 101-pair cable with PVC sleeves over connectors before application of plastic mold and epoxy resin.

**COMPLETELY WATERPROOF,** the cable splice will now effectively preclude water and moisture. The hardened plastic core can resist impact and has an insulation value of 750 volts per mil.



**EPOXY RESIN** and hardener mixture is poured into plastic mold. The fluid epoxy resin surrounds each conductor in the splice and, after hardening, forms solid protective core. Resin hardens in about 45 minutes.

For example, one particular case involved the entrance of water into some PVC jacketed, aluminum-shielded, polyethylene-insulated, No. 19 AWG multi-conductor cables that are part of several auxiliary systems needed to maintain the transmitter area of the station.

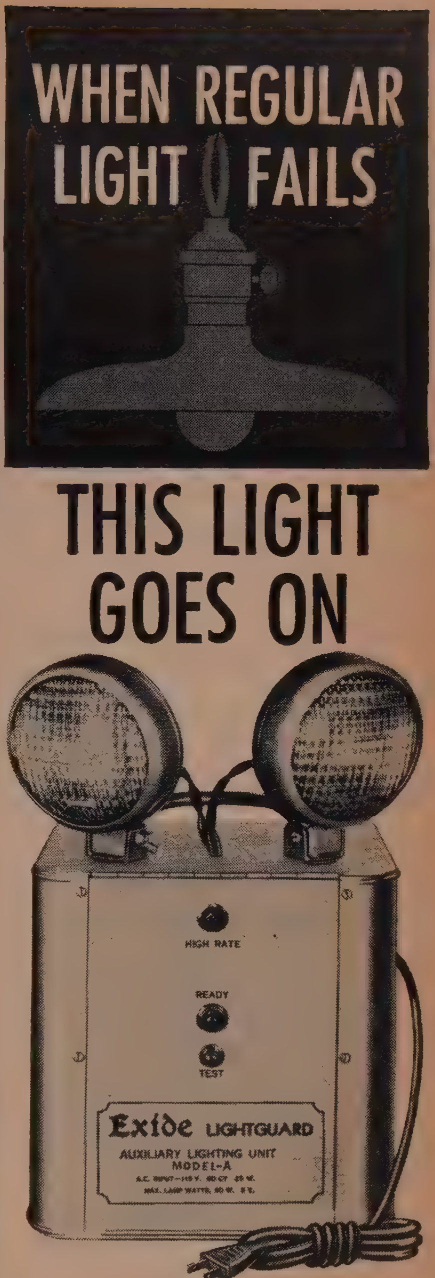
After consulting with C & S Products, the contracting firm, Nat Harrison Associates Inc., Miami, Fla., decided that the installation of Semper-Seal kits was the most practical solution to the problem.

Semper-Seal kits consist of plastic molds which are attached permanently over the splices and filled with an on-the-job, syrup-type mixture of epoxy resin and hardener. The liquid, which has an insulation value of 750 volts per mil, surrounded every conductor including the 101-pair cables and solidified in approximately 45 minutes. It penetrated 1-in. to 1½-in. longitudinally into the cables measuring from where the shield and jacket had been removed. With this hard core around each wire, water can not "short out" circuits. All the conductors were megohmed and loop-tested for continuity before and after the pouring process. Each one indicated a satisfactory reading.

The encapsulating of over 100 splices was accomplished at great savings. In the past, costly waterproofing devices included extensive nitrogen-purging operations, waterproof splice boxes and permanent dry-air pressure devices, none of which are required with this epoxy method.

---

**HONORARY MEMBERSHIP** in the Chicago Electrical Estimators Association is awarded to Walter E. Brand, vice president and chief engineer, Newbery Electric Corp., Los Angeles, Calif. Presenting mounted certificate is association president J. D. Garrison. Accepting for Brand is CEEA charter member Ray Ashley, a research and consulting engineer and recognized authority on electrical estimating. Before moving west, Mr. Brand was a member of the estimators association for some 20 years. He is credited with developing practical procedures for analyzing electrical installation labor costs, particularly in the roughing-in and cable-pulling operations.


WHEN REGULAR LIGHT FAILS

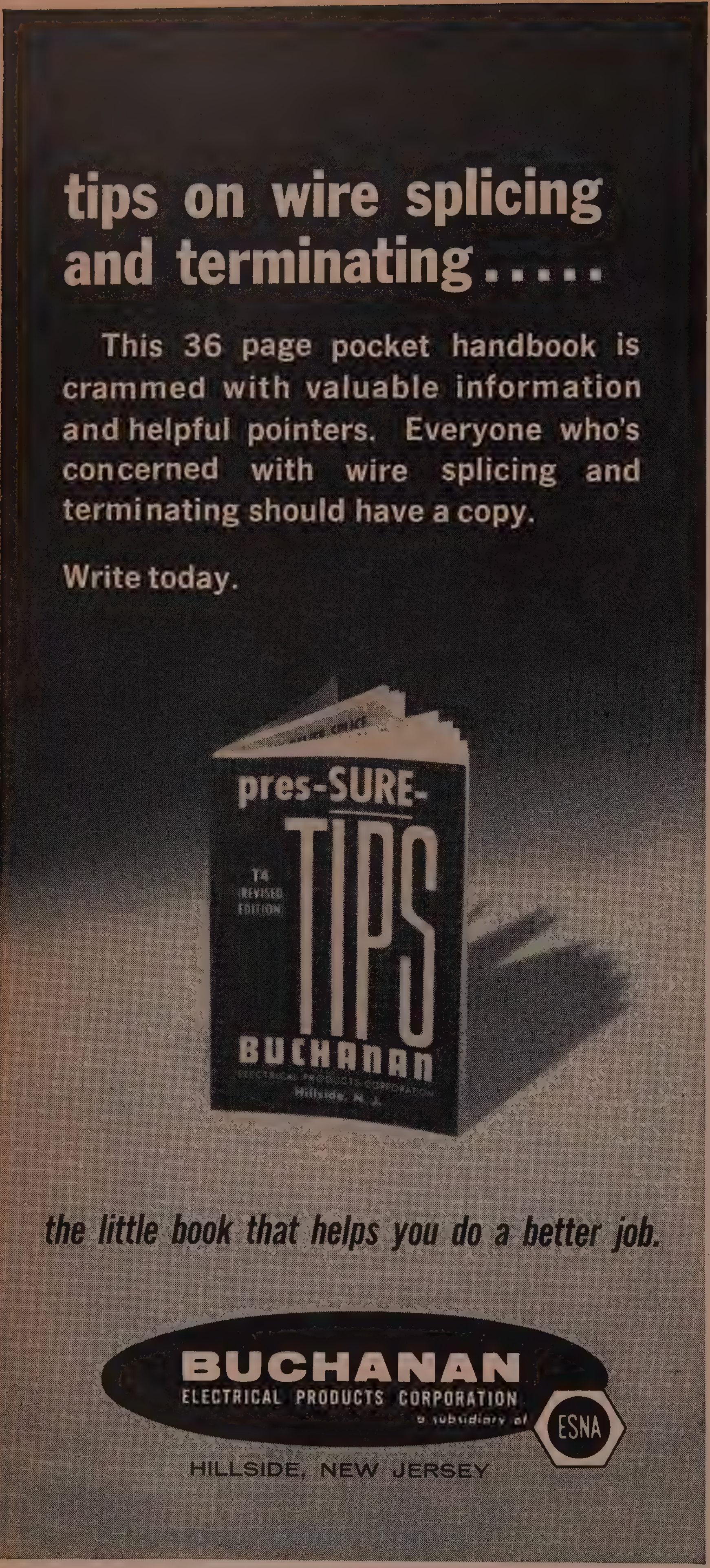
THIS LIGHT GOES ON

EXIDE LIGHTGUARD®

Easy-to-install emergency lighting unit. Goes on automatically when your regular power fails. Just plug into outlet—that's all you do. Protects you from risks of sudden darkness—panic, injury, damage, theft. Low in cost. Built-in charger keeps powerful Exide battery ready for use at all times. Several models. See them at your distributor's. Or write Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

Exide®

INDUSTRIAL MARKETING DIVISION
The Electric Storage Battery Company
ESB



**tips on wire splicing and terminating.....**

This 36 page pocket handbook is crammed with valuable information and helpful pointers. Everyone who's concerned with wire splicing and terminating should have a copy.

Write today.

*the little book that helps you do a better job.*

**BUCHANAN**
ELECTRICAL PRODUCTS CORPORATION
a subsidiary of ESNA
HILLSIDE, NEW JERSEY

SEE US AT WESCON SHOW BOOTH #205

## 115-KW LOAD IN RESIDENCE

[FROM PAGE 87]

tion of opposing heat loss from the house into the uninsulated attic crawl space. The insulation above the basement ceiling is required (even though the basement is heated) to prevent conduction heat loss up from the heating cable installed in the basement ceiling.

An important feature of electrical heating installations is control of relative humidity. In this house, exhaust fans operated by wall-mounted humidistats maintain an atmosphere containing about 35 to 45% relative humidity at 70°F. The fans eliminate buildup of moisture due to water usage (as in kitchen, bathrooms, laundry room). The humidistats sense objectionable moisture and automatically turn the fans "on" and "off" to keep a proper moisture level in the house. This eliminates such conditions as sweating windows, damaged window sills, moisture in the insulation (reducing its effectiveness), rot and damage to wood and peeling of paint.

An additional environment feature of this house is the air conditioning. Two air conditioning units in the attic crawl space—3-ton and 2-ton—share the cooling task. An interesting note on this installation is that the thorough insulation treatment of the house has kept the house cool enough through 90° outside temperatures without need for air conditioning.

Martin Katzman was the lighting consultant on this job.

**Here's the Electrical Load . . .**

| | |
|---|---|
| Water Heaters (2 @ 9 kw) | 18 kw |
| Air Conditioning | 5 kw |
| Electric Cooking | 14.8 kw |
| Clothes Dryer | 4.6 kw |
| Lighting | 12.6 kw |
| Space Heating (Ceiling Cable) in House | 36.3 kw |
| Garage Heating (Ceiling Cable) | 4.0 kw |
| Snow Removal Cable in Driveway | 12.9 kw |
| Miscellaneous Load | 6.5 kw |
| TOTAL LOAD | 114.7 kw |

**Service Demand Capacity . . .**

Two 4/0 per hot leg in 3-in. conduit = 2 x 230 amps x 80% (derating for 4-6 conductors) = 368 amps per hot leg
220 volts x 368 amps = 80 kw

**Here's the Energy Cost Rate . . .**

$6.00 for first 200 kwhr
2.05¢ per kwhr for next 200 kwhr
(i.e., $10.10 for first 400 kwhr)
Plus 1.5¢ for each additional kwhr
(Plus raw material charge of 0.176¢ per kwhr over base rate charge)

You don't have to look down the barrel to load this piston tool

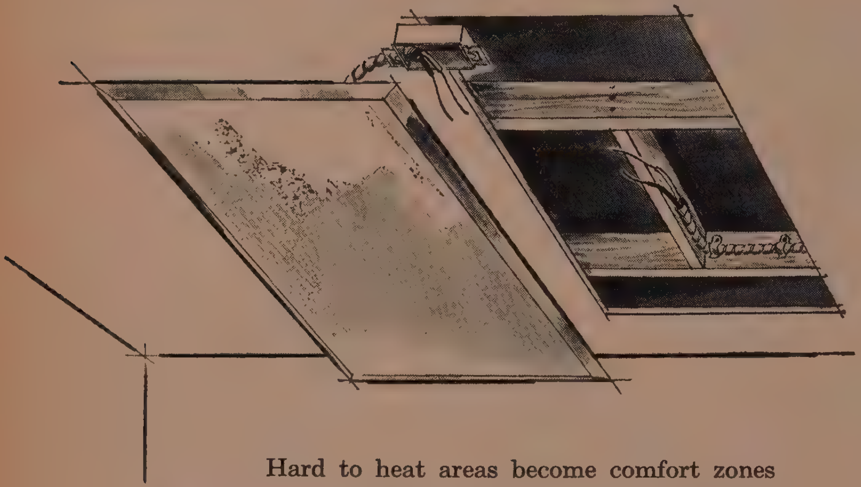
new Nelson LO-V* powder-actuated piston tool is breech-loaded. Threaded and headed fasteners
r the tool at the top, and are actually pushed through wood and metal into concrete or steel. This
es the LO-V the world's safest piston tool. It's light, compact and rugged, too. Operators love the
ue ejection system of the spent cartridge. Makes their fastening jobs simple and fast (as well
afe), and helps expedite the bosses' work flow, too. The Nelson LO-V uses safe, easy-to-work-with
ercaps for the most efficient use of powder power. Get full details today. Send for a free folder
he amazing new LO-V and universal HI-V powder-actuated tools. Dealer Inquiries Invited.
SON DISTRIBUTOR PRODUCTS, Division of Gregory Industries, Inc., Dept. C, Lorain, Ohio.

GREGORY
INDUSTRIES

Electric Heat is featured
in Gold Medallion Homes
Equipped by General Electric

GOLD MEDALLION HOME
LIVE BETTER ELECTRICALLY

**No 'hard to heat' areas with General Electric's radiant ceiling panels**



Accent on VALUE

Hard to heat areas become comfort zones . . . all the space-saving, no-maintenance benefits of embedded ceiling heat can be offered to new and remodeled homes, with General Electric's new radiant ceiling panels.

An exclusive wire grid heating element is embedded in tough plastic. Parallel paths of wire cover the entire panel area, for even, efficient heat distribution. Panel is backed by ¾″ glass fiber blanket insulation.

The 5′ x 2′ x 13/16″ panel can be painted to match ceilings, is controlled by an individual General Electric thermostat.

Pre-drilled holes accommodate wood screws or toggle bolts. Flexible metallic conduit has junction box attached, for quick and easy installation. Panel can be surface or flush mounted in any type ceiling, from plaster to concrete. Weight is only 16 lb—rating, 700 w, 240 v.

The radiant ceiling panel is featured in the all-new General Electric line that brings you a "supermarket" of electric comfort heating equipment—offers the right answer to every heating problem.

For details and specifications, write Sect. 280-05-2, General Electric Company, Electric Comfort Heating Section, Appliance Park, Louisville 1, Ky.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

## ESTIMATING FORUM—XXII

[FROM PAGE 91]

With a sell or contract price that is 130% of the base cost, the multiplier for base cost determination is 1/130, or 0.77 (see Fig. 1, Col. 9).

Since material and labor are respectively 60% and 40% of the base job cost, the multipliers for these items are:

Material—60% of 0.770 = 0.462 (Fig. 1, Col. 10)

Labor—40% of 0.770 = 0.308 (Fig. 1, Col. 11)

The labor rate is $4.00 per hour. Therefore, the number of labor hours is ¼ the number of labor dollars. It follows that the multiplier for the labor hours will be ¼ that for the labor dollars. Hence, this multiplier is:

Labor Hours—¼ × 0.308 = 0.077 (Fig. 1, Col. 12)

In the Fig. 2 estimate, the labor insurance was listed in the labor column and subject to a 10% markup. It is also good practice to list insurance in the material column and treat it as a merchandising item. It has been frequently stated that such a listing may have a sales value.

If the insurance had been listed in the material column along with the direct job costs, it would have been subject to a 7% and 5% markup. This would have increased the estimated price about 0.8%.

### *Base Cost Range*

From an over-all study of Fig. 1, we learn the following interesting facts about projects with a MLR in the 60/40 category:

Base Costs (Job) range from 70% to 80% of the contract price.

Material Costs range from 40% (for jobs less than $5,000) to 48% for projects in the $3/4 million class.

Labor costs run from 25% (for small jobs with high markups) to 32% of the estimated sell price.

### *Estimator Experience*

Experienced estimators rely a great deal on the knowledge they have of completed projects and the percentages they have fixed in their minds. However, they must proceed carefully if they step out of their ordinary line of work. Direct job costs and duration are two items demanding careful study when special projects are involved.

More than 65,000 ft. of SPANG Steel Conduit is installed in the new $2,000,000 St. Mary's Dominican High School, New Orleans, Louisiana. Conduit will protect wiring for general lighting, phones, air conditioning and electric heating, television, commercial system and clocks.

# Want dependability? Try SPANG®!

You'll get it all the way—from on-time delivery to trouble-free installation.

Take the case of Lindsey & Morgan, the New Orleans electrical construction company that installed 65,000 ft. of SPANG Steel Conduit, made by Armco, at St. Mary's Dominican High School. Here's how L & M Partner Ralph Morgan ticked off the SPANG-dependability on this job:

- Conduit at the job site ahead of schedule.
- Bundled in steel strapping for easy handling, no bent lengths.
- Color-coded thread protectors for fast identification.
- Uniform product made for easy cutting, bending and threading.
- Smooth interior finish facilitated wire-pulling.
- Makes good appearance in exposed locations.
- All threads were in "go" condition despite long outdoor storage of some bundles.

*Dependability?* Yes, indeed! For this reason alone, Lindsey & Morgan uses Armco's SPANG Conduit regularly. And so should you. See your local SPANG Distributor.

For more information, write *Armco Steel Corporation, Armco Division, Middletown, Ohio.*

**Architect: Philip P. Cazalé, A.I.A., New Orleans**

**Consulting Electrical Engineers: Guillot, Sullivan & Vogt, New Orleans**

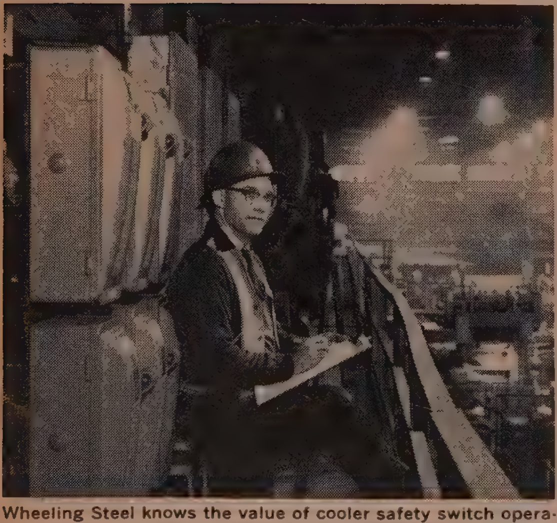
**General Contractor: Perrilliat-Rickey Construction Co., Inc., New Orleans**

**Electrical Contractor: Lindsey & Morgan, New Orleans**

**SPANG Distributor: Woodward, Wight & Co., Ltd., New Orleans**

ARMCO **Armco Division**

# coolest



Wheeling Steel knows the value of cooler safety switch operation. Hundreds of Westinghouse switches have given years of trouble-free performance at their Steubenville, Ohio, plant.

Cool switches last much longer, and Westinghouse makes the coolest safety switch you can find.

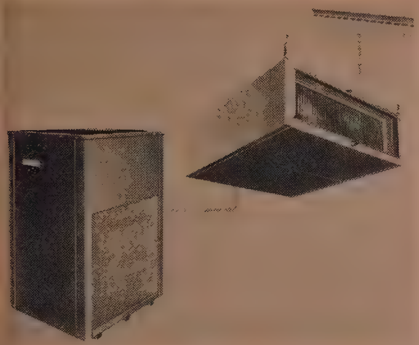
Take the contact area, for instance, where most heat is produced. An exclusive Westinghouse design has completely eliminated arcs from the contact area. Burning and beading don't exist there. Contacts last longer.

The De-ion arc quencher reduces heat by snuffing out arcs quickly. Joints produce heat, so Westinghouse eliminates joints with one-piece copper construction. Heat is reduced, and conductivity is improved.

Tin-plating of copper parts further reduces both heating and wear by providing lubrication, and corrosion resistance. These features help make Westinghouse the best buy in safety switches. Ask your Westinghouse representative for complete details, or write Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa. *You can be sure . . . if it's* **Westinghouse**

J-30341

# Product News



### Comfort Conditioning System (1)

In an all-electric, all-season approach to whole-house climate control, a new Chromalox Season-Aire electric comfort conditioning system has been announced. System includes a basic electric heating section, plus cooling, electrostatic filtering and cleaning, humidifying, dehumidifying, circulating, ventilating and deodorizing. These latter features can be added on as desired or all supplied as one complete system. One of the features is the patented air distributing baseboards located in each room with individual temperature control. These baseboards, called Smooth-Air units, are installed on outside walls and below windows and deliver conditioned warm or cool air into each room in a precise pattern. For room-by-room heating control in winter, a metal-sheathed electric heater located in the air supply of each unit and controlled by a thermostat keeps the room temperature at preset comfort level. The main part of the basic electric heating system is the Central-Air unit containing a twin impeller fan that moves the air at slow speed over a bank of metal sheathed heaters.

*Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.*

### Clamp (2)

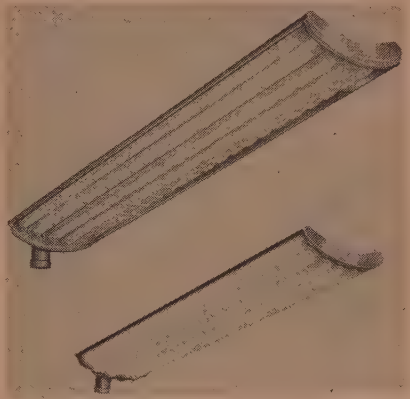
A new small mounting clamp for holding Ty-Rap installed wires, harnesses, conduit and cable has been introduced. Designed to fit snugly under the harness, the clamp is quickly installed with a No. 6 screw or rivet. Installation of clamp is made at the most convenient time before harness or cable is put in place. The Ty-Rap cable tie or identification strap is then slipped under the slot in the clamp and around the wire bundle. One clamp size with Ty-Rap ties or straps will accommodate wire bundles from ¼ in. to 4-in. dia. Clamp is ¾ in. long, ½ in. wide and ⅛ in. high. It will accommodate all sizes of Ty-Rap cable ties and identification straps.

*Thomas & Betts Co., Inc., Elizabeth 1, N. J.*

### Ballast (3)

A new ballast for use with 175-watt mercury vapor lamps is designed to operate with the new Banner Line of mercury vapor lamps. It provides reliable starting at minus 20°F. It has been designed for incorporation in unitized mercury vapor lamp heads. Ballasts weigh approximately 6¾ lbs. They are provided with input taps for 115, 120 and 125 volts. Class "F" insulation is used to allow ballast to operate in temperature up to 155°F.

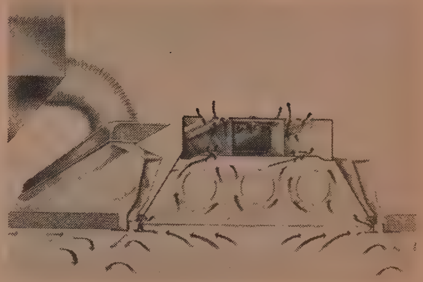
*Transformer Dept., Sylvania Electric Products Inc., Estes St., Ipswich, Mass.*



### Lighting Fixtures (4)

New "Flair Line" area and service station island lighting fixtures are available. Featuring a slim curved design, the line includes two series. "Flair" series is the basic unit, available in 32 models. It is furnished with 3, 4 or 6 lamps, in 18-in. or 24-in. widths and 6-ft or 8-ft lengths. "Royal Flair" is the deluxe series in this line. Four models are available, each with 6 lamps. They are furnished in 24-in. width only, in 6-ft or 8-ft lengths. It features a fluted, white acrylic plastic enclosure.

*Guardian Light Co., Oak Park, Ill.*



### Recessed Fixture (5)

Recessed lighting fixtures which remove the heat they generate before it enters the occupied space have been introduced. Heat produced by lighting units can be removed at the rate of 200 to 400 Btu per hour for each fixture. Fixture generated heat is removed into the plenum area above the ceiling and exhausted or recirculated through the cooling system. Air from room is drawn into fixture, entering around edges of diffuser and goes out through air slots in top of troffer. Lighting characteristics also are improved because heat removal reduces operating temperature of fluorescent lamps. The heat removal principle has been applied to two fixtures—the shallow line troffer and the multi-purpose Lumi-Flo air-supply unit.

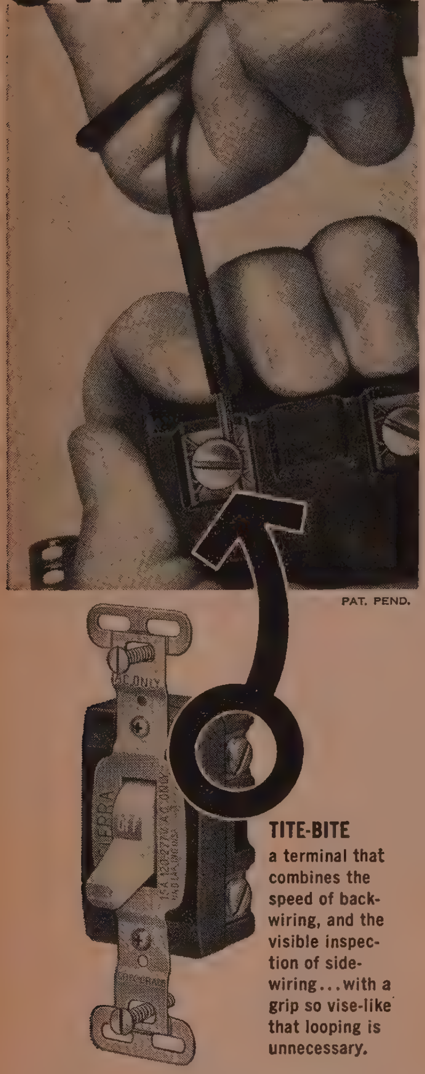
*Benjamin Div., Thomas Industries, Inc., 207 East Broadway, Louisville 2, Ky.*

### Clamp-Type Terminal (6)

A new saw-tooth, clamp-type terminal that provides increased wire holding power and improved electrical conductivity is now being offered on specification grounding devices. Clamp permits either back or side wiring. Eight openings in the base allow insertion of Nos. 10, 12 or 14 AWG wire for gripping by the saw-tooth edges, or the wires can be attached to the side of the devices with conventional screw terminals. Devices have double-wipe parallel contacts and triple-wipe grounding contacts. Break-off link will permit split wiring. It has been listed by UL and meets all Federal and REA specifications. It is available on double-outlet grounding devices rated 15 amps, 125 volts and 15 amps, 250 volts, with or without outlet box cover; 20 amps, 125 volts; and 20-amp, 125-volt outlets.

*Wiring Device Dept., General Electric Co., Providence, R. I.*

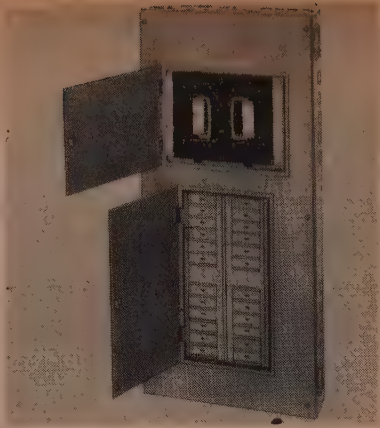
NEW
SIERRA
Q-T
SWITCHES



**TITE-BITE**
a terminal that combines the speed of back-wiring, and the visible inspection of side-wiring...with a grip so vise-like that looping is unnecessary.

SIERRA "Q-T" is the new quiet-type switch that can pass your most critical inspection. The "Q-T" is UL approved, meets all codes and standards. Moreover "Q-T" meets or exceeds all of the specifications normally applied to switches priced considerably higher.

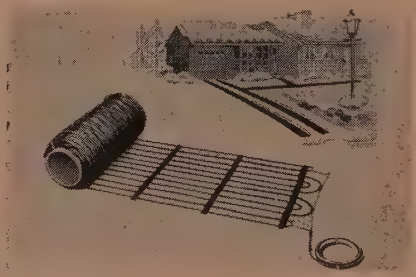
SIERRA ELECTRIC
CORPORATION
15100 SOUTH FIGUEROA STREET
BOX 85, GARDENA, CALIFORNIA
*Write for more information and catalog*



## Load Center (7)

A new 200-amp main disconnect load center for the all-electric home. It is a 200-amp main lugs only, split bus device, with fusible service disconnect and circuit-breaker branch circuits. It has two 100-amp fusible pullouts, and 24 to 40 breaker branch circuits. One 100-amp fusible pullout disconnect protects one of the branch-circuit sections and the other disconnect protects the second branch section. Lighting and appliance circuits may be connected to one section and heating circuits could be connected to other section. The door-trim is the E-Z removable type, interchangeable for flush or surface, equipped with two doors. Separate dead-fronts are of the new hook-on type.

*Wadsworth Electric Mfg. Co., Inc., Covington, Ky.*



## Snow Melter (8)

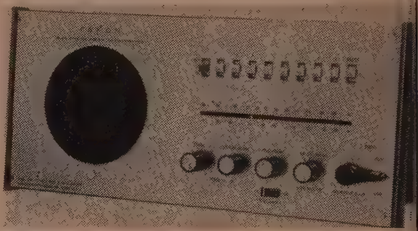
Electric "Snow-Mats" for embedding in blacktop to keep driveways, parking areas, walks, etc., free of snow and ice have been developed. They are completely assembled units of pre-spaced electric Line-O-Heat cable, for use on 230-240 volts, ac. They are 18 in. wide and available in 5-, 10-, 20- and 40-ft lengths for installation in limitless patterns and combinations. Each mast has 10-ft, non-heating, color-coded leads plus a positive braided ground encasing the heater.

*Smith-Gates Corp., Farmington, Conn.*

## Test Units (9

Two lines of high-voltage powe supply units—one for ac testing an the other for dc testing—are avai able for a wide variety of dielectr tests according to recommendation of ASTM D-149. Models HA ar designed for ac testing. They include six portable types with ou puts ranging from 2.5 to 25 kv 16 mobile, bench and console type with outputs from 5 kv through 2 kv; and six console types with ou puts of 50 to 75 kv. Models HD ar designed for dc testing. They include seven portable types with ou puts ranging from 5 to 25 kv, an eight bench and console types wit outputs from 25 through 100 kv.

*Multi-Volt Div., Multi-Amp Electronic Corp., Cranford, N. J.*



## Radio-Intercom System (10

New model 5500 AM/FM hom radio-intercom system consists of master and up to nine remotes. I is styled for flush-wall installation The FM tuner is equipped with a automatic frequency control (AFC which prevents drift. An AFC-of switch facilitates tuning in of weal or distant stations. As an intercom both the master unit and any o the remotes may call one another Pre-switching at master unit enables one remote to talk directly and in privacy with any other remote.

*Fanon Electronic Industries, Inc 439 Frelinghuysen Ave., Newar 14, N. J.*

## Thermostat (11

A "Dual-Duty" control whic combines an electric heat thermostat with a complete mounting plat arrangement which permits inclusion of switches, receptacles and/ or signal lights in the same enclosure has been announced. Unit mounts on a standard two-gang switch box or 4 in. by 4 in. outle box. Type 1A65-441 has singl pole thermostat; Type 1A66-44 has double-pole disconnect thermostat with positive "off" dial position.

*White-Rodgers Co., 9797 Reavis Rd., St. Louis 23, Mo.*

# 7 WAYS BETTER!

1 Adhesive permanently fused for lifetime splices

2 Conforms perfectly for perfect splicing

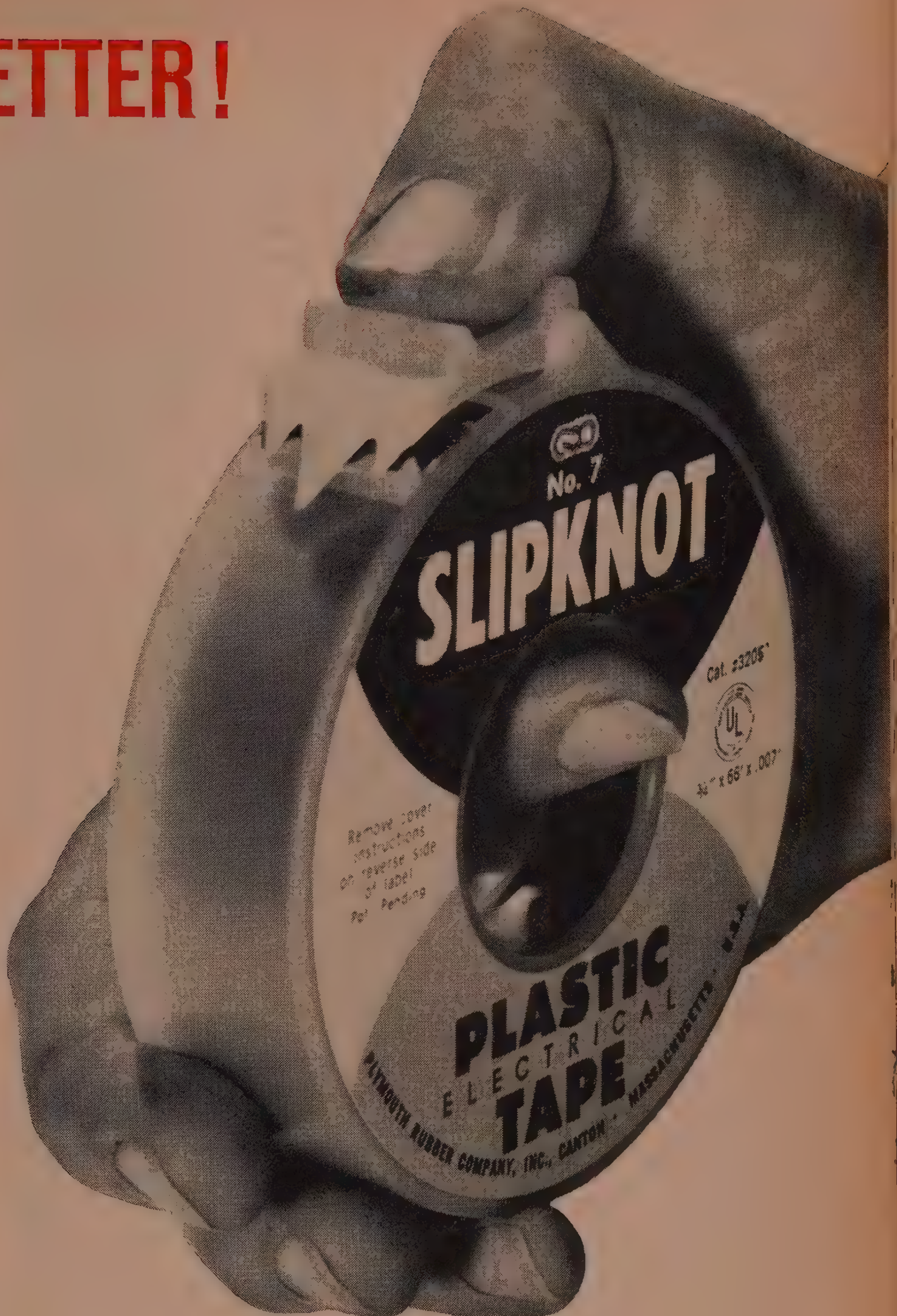
3 Controlled stretch — no dangerous thinning

4 Built-in "grab" — snugs and stays down

5 The choice of experienced electricians

6 Unvarying top quality in every roll

7 Exclusive FLIP-n-CUT® dispenser-cutter — FREE!



No. 7
SLIPKNOT
Cat. #3206
UL
3/4" x 66' x .007"
Remove cover instructions on reverse side of label
Pat. Pending
PLASTIC
ELECTRICAL
TAPE
PLYMOUTH RUBBER COMPANY, INC., CANTON · MASSACHUSETTS · U.S.A.

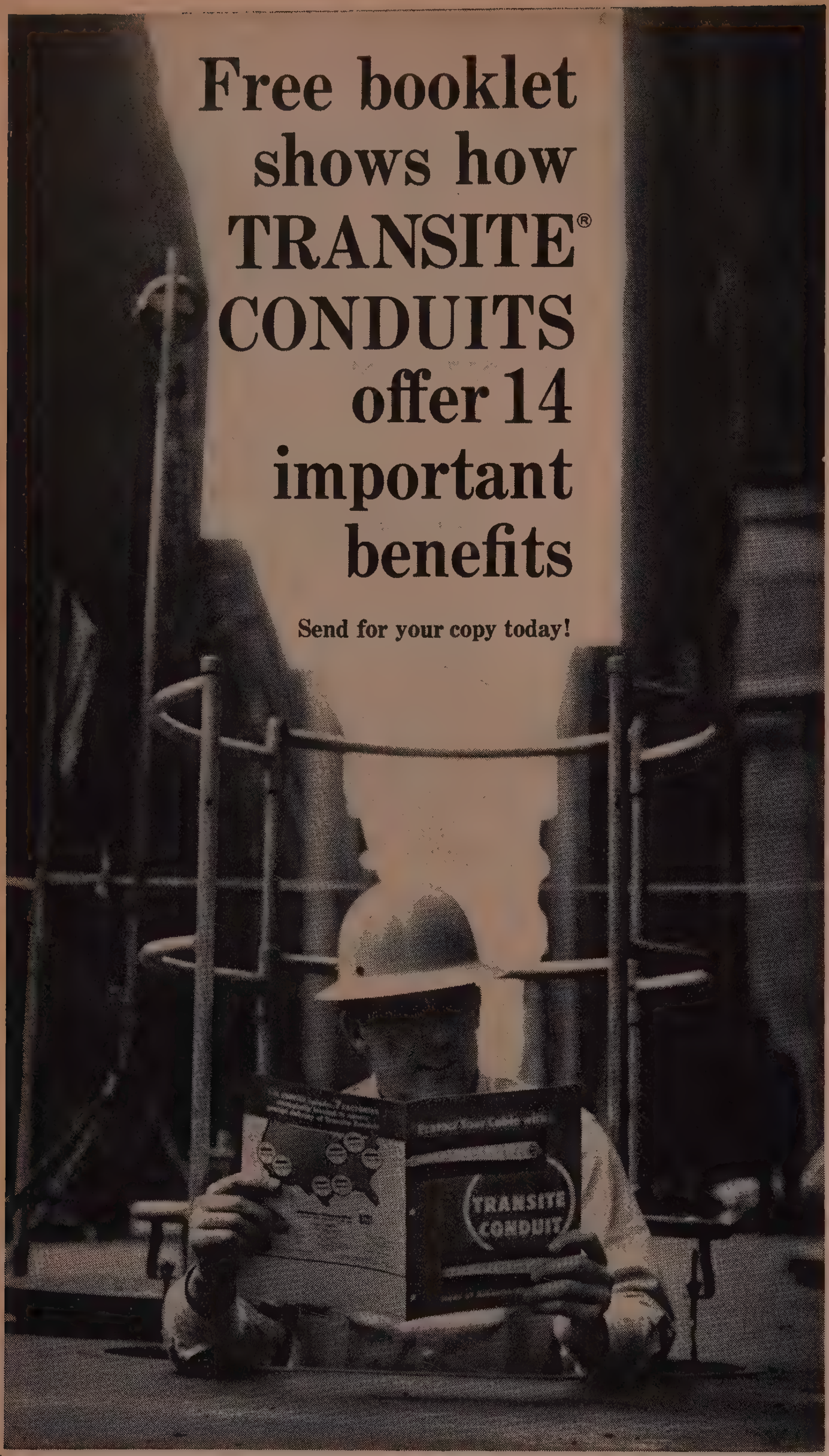
**FLIP 'N CUT®**, a Slipknot exclusive, speeds the job and saves you money. It's FREE with each 30′ · 44′ · 66′ roll!

## No. 7 SLIPKNOT

## PLASTIC ELECTRICAL TAPE

TAPES BY PLYMOUTH RUBBER COMPANY INC

PLYMOUTH RUBBER COMPANY, INC.
QUALITY SINCE 1896 CANTON, MASSACHUSETTS
Makers of SLIPKNOT FRICTION TAPE — most widely used in the world


Free booklet shows how TRANSITE® CONDUITS offer 14 important benefits
Send for your copy today!
TRANSITE CONDUIT

JOHNS-MANVILLE JM PRODUCTS

Box 362, ECM-8, New York 16, N. Y. In Canada: Port Credit, Ontario

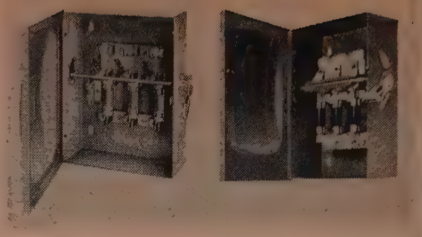
Please send me, without obligation, your facts and data book on Transite Conduits for electrical cables.

NAME__________

ADDRESS__________

CITY__________ZONE__________

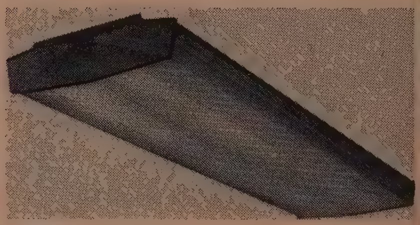
COUNTY__________STATE__________



**Safety Switches** **(12)**

A new line of safety switches designed for positive protection on residential, commercial and industrial applications has been announced. Line includes heavy duty and light duty fused switches with visible knife blade contacts that tell at a glance when circuit is disconnected. There is provision for use of from one to three padlocks. Heavy duty switches include units for operation at 30, 60, 100 and 200 amps; 250 volts dc and 240-480-600 volts ac in NEMA 1 enclosures. Other units rated up to 1200 amps are also available. Light duty switches for residential and commercial applications are designed for operation at 30, 60, 100 and 200 amps; 240 volts ac in NEMA 1 and NEMA 3R (raintight) enclosures. Others for operation at up to 400 amps are available.

*Arrow-Hart & Hegeman Electric Co., Hartford, Conn.*



**Luminaires** **(13)**

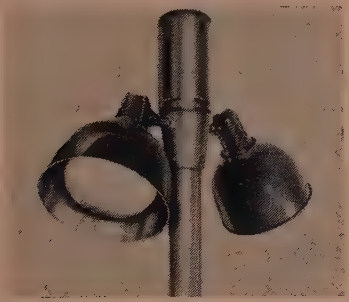
The LPI Criterion I and Criterion II fluorescent luminaires are now listed by UL for direct surface mounting on combustible, low-density cellulose fiberboard ceilings. They feature completely luminous design and incorporate ballasts with automatic resetting thermostats. Criterion I luminaire complies with the IES "scissors curve" criteria for limiting direct glare. The Criterion II is identical in appearance and provides higher footcandle levels with excellent brightness control, but it is not designed to comply with the "scissors curve." Luminaires use lamps up to 3100 lumens, and are available in 2-lamp and 4-lamp-tandem models. Bulletin is available.

*Lighting Products Inc., Highland Park, Ill.*

**Adhesive-Sealant** (14)

A new all-purpose silicone rubber adhesive-sealant in a squeeze tube that requires no added catalyst, which adheres to most materials without priming, has been placed on the market. Identified as RTV-102, the material can be applied from the tube and cures in place at room temperature to form a durable, resilient silicone rubber. It is capable of withstanding temperatures from minus 75°F to 300°F for extended periods and up to 500°F for shorter time periods.

*General Electric Co., Waterford, N. Y.*



**Lighting** (15)

A complete mercury vapor lighting package permits more wide-area lighting with a new 2-lamp 1000-watt ballast. The "Dual-1000" constant wattage ballast is available for mounting in pole-base or pole-top as a complete assembly that includes ballast, pole-top adapter, and all-aluminum floodlights designed specifically for high-efficiency 1000-watt R-80 color-improved mercury lamps with sealed-in silvered reflectors.

*Stonco Electric Products Co., Kenilworth, N. J.*

**Gearmotor** (16)

New double-reduction, parallel-shaft gearmotor designated Type 5 GD has been introduced. Features include: a pyramidal case; a solid-shank, built-in primary pinion; a one-piece supporting case; normalized castings. In addition to standard dripproof motor, which is normally supplied, the 5 GD can be provided in totally-enclosed and explosion-proof models. The 5 GD is also available with the new Ever-seal encapsulated windings for applications where positive protection is required against salt spray, chemicals, water, heat, cold, or any adverse environment. Literature is available.

*U. S. Electrical Motors Inc., Los Angeles, Calif.*

1 MILLION OF THESE PROVE GAMEWELL CAN HELP YOU

The next time you see a municipal fire alarm box we invite you to go up to it and read the name on the box. 9 times out of 10 we know you'll see "Gamewell". That's pretty good proof of performance, isn't it? ■ You may not realize that Gamewell has been the choice of thousands of firms to protect industrial, commercial and institutional buildings with Flexalarm fire alarm systems inside the building. ■ Find out how our more than 100 years of specialization in the development and manufacture of automatic fire detection and alarm systems can solve your alarm system installation problems—dependably, economically and attractively. Write The Gamewell Company, Department 1407, Newton Upper Falls 64, Massachusetts. A Subsidiary of E. W. Bliss Company.

BLISS Gamewell®

FIRST...WHEN SECONDS COUNT.

When you need better-quality circuit breaker equipment . . .

**HEINEMANN**

Everyone talks "quality". Heinemann guarantees it. With a five-year "repair-or-replace" guarantee against defects in materials or workmanship.

This guarantee applies to all the circuit breakers we make, not just to a few special types.

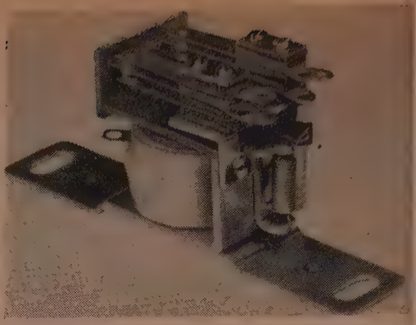
Surprisingly, you don't have to pay an exorbitant premium for Heinemann premium-quality equipment. On many items we're definitely competitive in price. And where we're not, we're only a little higher.

The cost difference—if any—is well worth it. Heinemann hydraulic-magnetic circuit breakers are temperature-stable. They never have to be derated, and they won't plague your customers with hot-weather nuisance tripping.

Heinemann offers a diversified line of service-entrance equipment, service centers, and protected-receptacle units, in either indoor or outdoor types. Our Bulletin 1000 will give you full information on the entire line — including our compact 200-amp service-entrance equipment. Write for a copy.

HEINEMANN ELECTRIC COMPANY 2606 Brunswick Pike, Trenton 2, N.J.

SA 2594



**Relays** (17)

A new line of DPDT general purpose relays, strap-mounted for installation into surface or flush outlet boxes, is available. Designed for both replacement and new construction use, the relay line consists of ten models (five with ac voltage coils and five with dc voltage coils) to cover 60 possible contractor applications. Contacts, rated at 10 amps, are silver with a diffused surface of pure gold. Coils are wound on nylon bobbins, and wrapped with acetate yarn, while springs are made of stainless steel. Terminals are pretinned solder lugs, and all ferrous parts have cadmium plate and chromate film finish. Voltages range from 6 volts to 250 volts, both ac and dc.

*Edwards Co., Inc., Norwalk, Conn.*

**Lighting Fixture** (18)

Alzak high intensity high bay lighting for incandescent or mercury vapor lamps in both direct and uplight styles is now available. Vented neck construction assures proper operating temperatures. Multiple grouping arrangements are available. Duratch, Durex and solid neck styles. Catalog is available.

*Wheeler Reflector Co., Inc., Hanson, Mass.*

**Drill** (19)

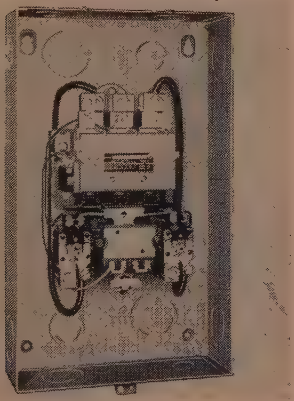
A new masonry drill, electric-powered Model "300-E" handles diamond bits up to 6 in. in diameter. It weighs 60 lbs. Features nclude a friction-free screw feed nd hand crank that is built "on he angle." An adjustable column-nount adapter is provided for use vith different length or diameter ipes. A carrying handle projects from drill's 2-hp electric motor. Special cast aluminum alloy base permits drilling next to walls and in corners. A power box is provided on the "300-E" with on-off switch and convenient outlet for electrical accessories.

*E. J. Longyear Co., Longyear Building, Minneapolis 2, Minn.*

**Ballast (20)**

A new plastic-sign fluorescent lamp ballast capable of operating any four-lamp combination of 6-, 7-, or 8-ft slimline lamps has been introduced. Designated model 6G3669G14, the ballast is supplied in white bonderized case with 14-gauge leads. It meets requirements for lamp starting in ambient temperatures as low as 0 degrees F. It is listed by UL.

*General Electric Co., Schenectady 5, N. Y.*

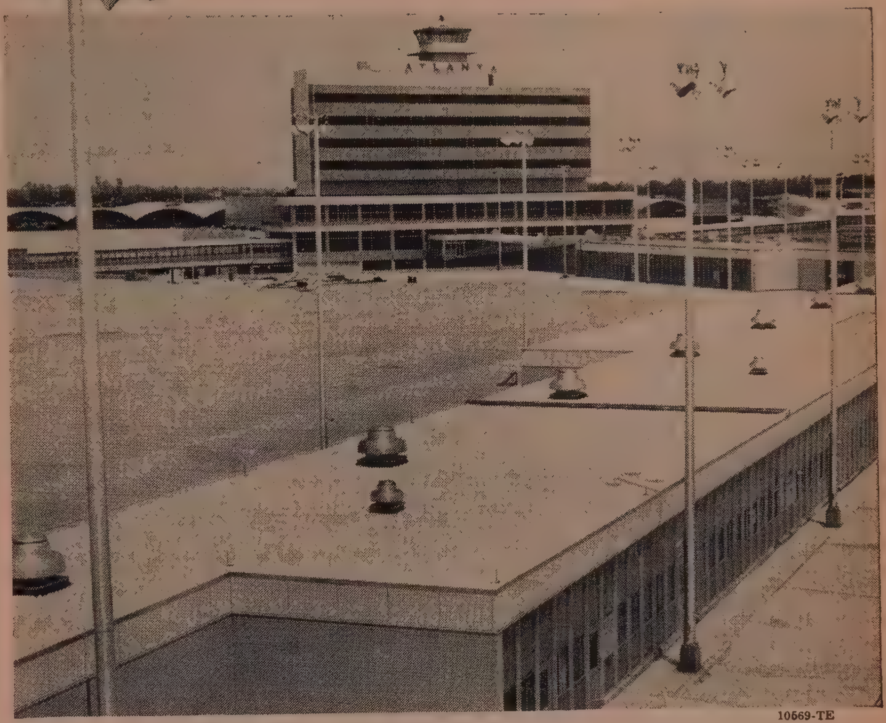


**Starter (21)**

A new Size 4 magnetic starter which features more wiring room has been introduced. It has a tamper-proof, non-mechanically linked trip-free thermal overload relay. It is offered with a choice of bimetal, compensated or non-compensated thermal relays as well as melting alloy relay. It has dual voltage, dual frequency coils, 110/220 or 220/440, 50/60 cycles. Coils are encapsulated in an epoxy resin resistant to fungus, combustion, impact and moisture. Pressure terminals throughout permit rapid installation. Bulletin 14-B4 is available.

*Furnas Electric Co., 1067 McKee St., Batavia, Ill.*

ATLANTA'S NEW AIR TERMINAL SERVICES JET-AGE TRAFFIC



10569-TE

architects and engineers: Robert and Company
electrical contractors: E. S. Boulos Company

WITH THOMPSON SERVISAFE POLES

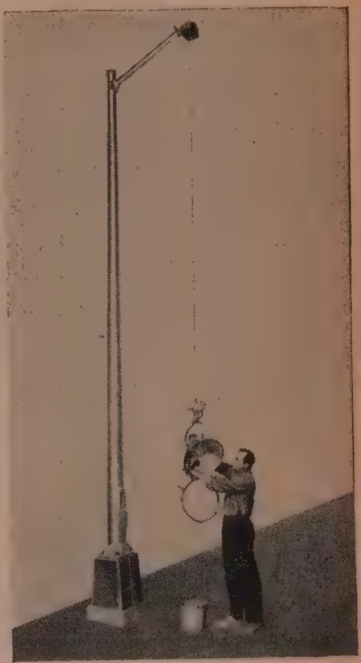
Robert and Company, prominent engineering firm, selected Thompson *Servisafe* floodlighting poles for the passenger loading area of Atlanta's new, ultra-modern airport because adequate illumination is vital to a jet-age air terminal. Larger aircraft with greater dimensions require high floodlighting . . . to eliminate dangers to passengers and service personnel, to reduce glare, to simplify fueling, inspection and loading.

SERVISAFE poles have exclusive "on-the-ground" one-man maintenance to permit fast, safe, all-weather luminaire servicing. They reduce maintenance costs and prevent electrical or climbing hazards. Available in a wide range of types, designs and heights to meet individual requirements, *Servisafe* units can be used with all standard pendant luminaires and bail suspended floodlights.

Request full details on specifications, costs and installation.

T·E

THE THOMPSON ELECTRIC CO.
P. O. Box 873-D • Cleveland 22, Ohio



5 to 23kv cable splices to make?

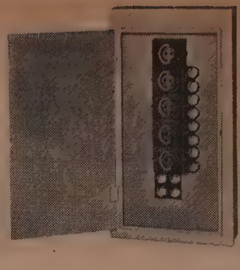
There's a PLM Kit to simplify the job!

Splicing armored cable . . . non-metallic sheathed cable . . . lead-covered cable? There's a PLM Splicing Kit to simplify the job and insure correctly designed splices with a minimum of time and effort! Each PLM Splice Kit contains all materials needed for making one correctly-designed splice (including aluminum or galvanized steel casing), together with clear, step-by-step instructions for making it. Need for ordering or stocking many separate items is eliminated.

PLM Splicing Kits, complete with casings, are also supplied for making 3 and 4-way splices with armored cable. PLM kits and fittings are fully listed and described in PLM 52-page catalog 301. Write on letterhead for your copy.

PLM Products, Inc
TERMINATING AND SPLICING ACCESSORIES

3875 WEST 150th STREET • CLEVELAND 11, OHIO



**Switch** **(22)**

A new service entrance switch with five pullouts and 12 plug-fuse circuits has been introduced. The parallel type switch is designed with one 60-amp lighting pullout controlling 12 30-amp plug-fuse circuits, one 60-amp and three 30-amp utility pullouts. The plug-fuse circuits are for lighting, appliance and electric-heating loads. Switch is built with 150-amp line lugs for 120-240-volt, 3-wire, solid-neutral installations. Both surface-mounting and flush-mounting enclosures are available.

*American Electric Switch Div., Clark Controller Co., 1146 East 152d St., Cleveland 10, Ohio*

**Abrasive Cut-Off Machines** **(23)**

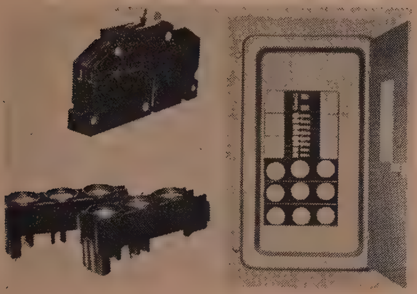
A new line of abrasive cut-off machines for handling exacting metal cutting requirements has been announced. The line includes three, dry cutting models—two straight cutting machines and one swivel-type, for angle cuts up to 60°. The 14-in. straight cutting models can be used either as a bench model or with stand. Its capacity covers most 4 in. structural shapes and up to 2 in. solid stock. Either manual or magnetic starter control, with overload protection is available. The 20-in. unit is a heavy duty, straight cutting model, for production cutting of larger diameters. The 20-in. angle cutting model has a pivot built into the base.

*Oster Manufacturing Co., Div. of Plymouth Corp., Wickliffe, Ohio*

### Substations (24)

Previously available with 3-phase capacities from 75 to 500 kva self-cooled, Power-Zone package unit substations now are offered with a forced-air cooling system which increases capacity to 667 kva. The new system is equipped with a temperature alarm to permit maximum output without damage. Fused or non-fused load break air interrupter switches or oil cutouts may be specified for primary sections. Transformer sections feature 3-phase Class H insulated ventilated dry-type transformers. Secondaries can be equipped with molded case circuit breakers, fusible switches and/or motor starters. Bulletins 6110 and SD-234 are available.

*Square D Co., Mercer Road, Lexington, Ky.*



### Plug-In Fuse Units (25)

Fuses and breakers are mixed in same box with new plug-in units. Circuit breakers and fusible units are completely "plug-in." All are field installed. With this new choice of installation, contractor can use plug-in main breakers; twin size breakers for appliance circuits; and either breakers or plug fuse units for lighting circuits. Literature is available.

*Zinsco Electrical Products, 729 Turner St., Los Angeles 1, Calif.*

### Lamp (26)

A new lamp, especially designed for the Chavez Ravine Dodger Stadium, is now available for general commercial and industrial use. It is a 1200-watt R80 incandescent Hi-Spot lamp with an internal silver reflector. Designed with an average rated life of 1500 hours at 120 volts, this light source produces a minimum of 250,000 beam candlepower. The R80 is made from "Pyrex" glass and can be used outdoors in such locations as sports fields, railroad yards, parking lots and loading areas.

*Radiant Lamp Corp., Newark, N. J.*

To save time . . .

Every Tool Box Needs a compact, easy-to-carry

RIDGID®

Drop Head Threader Set

Snap a die head in the ratchet ring . . . cut your thread! It's as simple as that with a RIDGID drop head threader. Heads can't fall out . . . dies reverse quickly for close-to-wall threading. Finest quality RIDGID long wearing dies. Straight thread dies available.

Call Your Supply House!

Hand Carrier Free With All Sets Except No. 12-R

(Order in sets or any combination)

**Exposed Ratchet Type**

For pipe: ⅛" to 1"—00-R; ⅛" to 1¼"—111-R; ⅛" to 2"—12-R

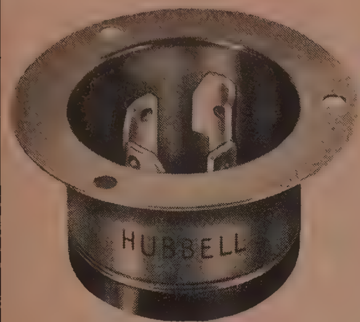
For bolts: ¼" to 1"—00-RB

**Enclosed Ratchet Type**

For pipe: ⅛" to 1"—0-R; ⅛" to 1¼"—11-R

RIDGID®

The Ridge Tool Company, Elyria, Ohio, U.S.A.



SUPER
Twist-Lock®
MOTOR PLUG BASES

**LEFT:** No. 3434 Super "Twist-Lock" 4- wire male motor plug base for 30 amperes, 250 volts AC-DC, or 30 amperes, 600 volts AC.

**BELOW:** Yellow represents cross-section of standard sized 20 ampere, 4-wire male motor plug base for 250 volts AC-DC, or 10 amperes, 600 volts AC. Note how much smaller No. 3434 Super "Twist-Lock" unit is, even though rated 10 amperes greater.

NO. 3434

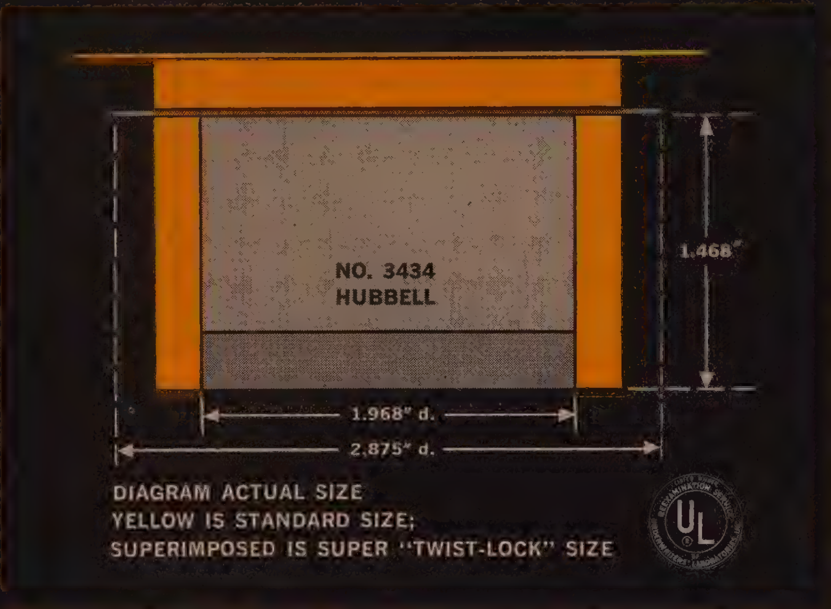


DIAGRAM ACTUAL SIZE
YELLOW IS STANDARD SIZE;
SUPERIMPOSED IS SUPER "TWIST-LOCK" SIZE

NOW—MOTOR PLUG BASES IN SPACE-SAVING DIMENSIONS

Super "Twist-Lock" Devices Handle Higher Amperages in Less Space

When a matching connector is plugged into a Super "Twist-Lock" motor plug base, a clockwise twist locks it against accidental disconnection. Deadfront construction seals out dust, lint, metal chips, etc.

Super "Twist-Lock" devices are much more compact and lighter in weight than standard models. Designers of machines and power tools specify them because they gang closely and reduce wiring time.

Super "Twist-Lock" male or female motor plug bases in polarized grounding or ungrounded models are available in 10-, 20-, and 30-ampere ratings for 2-, 3-, 4-, or 5-wire circuits.

Super "Twist-Lock" motor bases, cord caps, connector bodies, and receptacles are described in our Catalog No. 29. Or write for 24-page brochure H-1425 on the "Twist-Lock" line.

HARVEY
HUBBELL
INCORPORATED
Bridgeport 2 Connecticut

®"Twist-Lock" is a registered trademark of Harvey Hubbell, Incorporated

**Fluorescent Fixture** **(27)**

Two new fluorescent lighting fixtures, Sabre 12 and Sabre 16, have been announced. They are designed to provide high lighting efficiency with good brightness control in the lighting of stores, schools and offices. The Sabre 12 is a 2-lamp fixture, 13⅜ in. wide; the Sabre 16 is a 2-, 3- or 4-lamp fixture, 17⅜ in. wide. Both are available in 4- and 8-ft lengths. The self-hinging closure in convenient 4-ft lengths provides easy access from either side for relamping and cleaning. Brochure is available.

*Miller Co., Meriden, Conn.*

**Fittings** **(28)**

Flexible steel conduit screw-in connectors and couplings have been announced. They include "screw in" or "twist-in" connectors and couplings for ½-, ¾- and 1-in. flexible steel conduit. Die cast construction enables the installer to screw these fittings into the Flex. They are UL listed. Catalog is available.

*Allen-Stevens Conduit Fittings Corp.,* 33-53 62*d St., Woodside* 77, *N. Y.*

**Switch** **(29)**

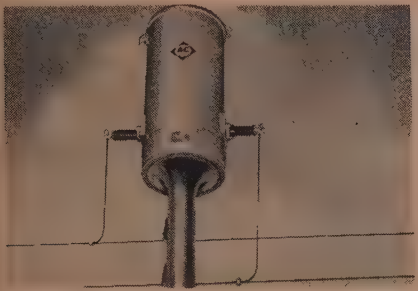
New ac reversing drum switches are available in two sizes to cover manual polyphase reversing requirements through 7½ hp. An adjustable control lever for remote operation—one of a choice of operators—can be rotated 360°. The selection feature provides adjustability to any one of 16 positions and permits easy operation of switches mounted at awkward angles or in confined locations. Two basic mechanisms are available—field convertible from maintained in both directions to momentary in both directions; and convertible from maintained-left, spring returned-right, to maintained-right, spring returned-left. Devices are available in NEMA 1 enclosures for surface mounting and as flush type units for oiltight, machine-cavity mounting.

*Cutler-Hammer, Inc.,* 228 *N.* 12*th St., Milwaukee* 1, *Wis.*

**Lamps** (30)

A new line of beam-controlled mercury vapor lamps which have their own metallic reflector built into the bulb, has been introduced. They will be available initially in 400-watt R60 bulb and 1000-watt R80 bulb sizes, and are expected to have many applications in the commercial and industrial field as well as for recreational lighting. The lamps have a useful life of 12,000 to 15,000 hours. The R60 and R80 lamps operate on standard ballasts.

*Westinghouse Electric Corp., Bloomfield, N. J.*



**Transformer** (31)

A new concept in distribution transformers in which the tank arrangement is a functional part of the lighting pole has been introduced. Available in a standard range of sizes, 50 kva, 18 kv and below, the transformer has its circuit breaker at the bottom of the rounded tank. Secondary terminals project from transformer base into a connection compartment equipped with access panels. Secondary voltage needs are served by directing low voltage lines down through the hollow support pole and underground.

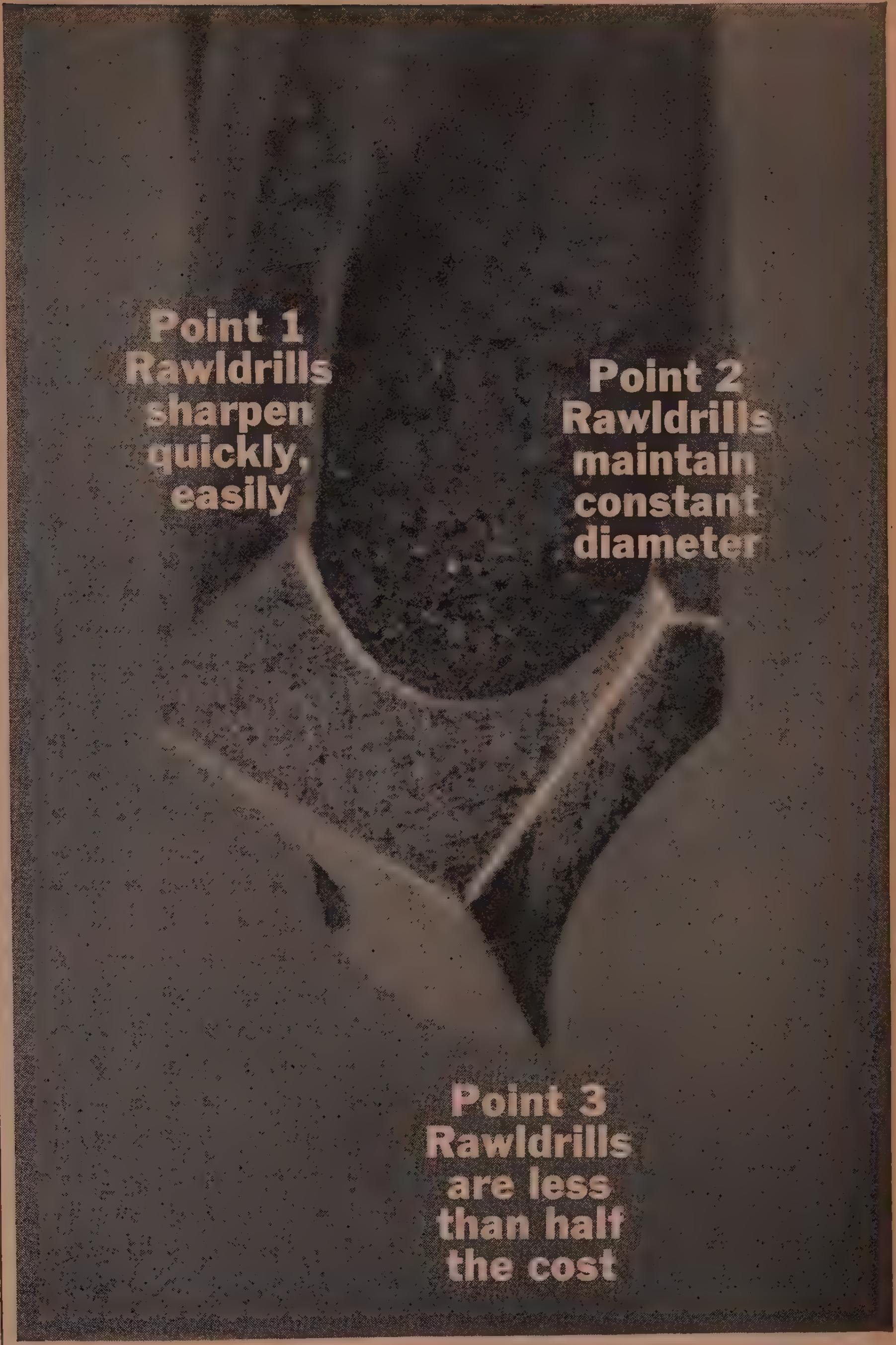
*Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.*

**Amplifier** (32)

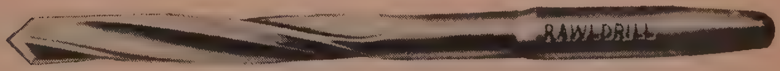
New electric magnetic amplifier has self saturating bias winding. This line of amplifiers combines solid state electronic components with magnetic reactors. The 60-cycle, input line is tapped and by means of silicon diodes is converted to direct current thus obtaining self saturation of the bias winding. Signal and load circuits are isolated. Unit is completely enclosed in ventilated case and supplied with meter mounted on front panel. Standard units are available in seven sizes from 5 to 1000 watts, 24, 80 or 160 volts dc; 120 or 240 volts ac.

*Acme Electric Corp., Cuba, N. Y.*

**For drilling in masonry**


Point 1
Rawldrills sharpen quickly, easily
Point 2
Rawldrills maintain constant diameter
Point 3
Rawldrills are less than half the cost

Rawl percussion drills for masonry have only three surfaces to grind. They can be sharpened quickly and easily on a grinding wheel by someone with little experience. Sharpen them again and again—they constantly maintain their original diameters. ☐ In the most popular sizes, Rawldrills are approximately half the cost of carbide-tipped drills. And they last much longer. The same drill can be used either for hand drilling or with a power hammer. ☐ Full details on Rawldrills are available in our 48-page pocket-sized "Handbook of Masonry Anchoring." Send for your free copy.



RAWL® DRILLS

The Rawlplug Company, Inc.
212 Petersville Rd., New Rochelle, N.Y.

Please send copy of "Handbook of Masonry Anchoring."

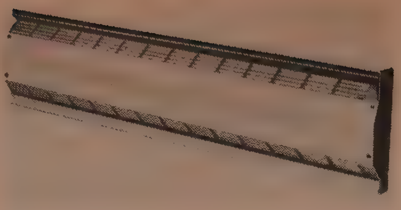
Name........................................
Firm........................................
Address........................................
City........................................State........................................

You have to go a long way...
to match "EAGLE" quality!

A long way, indeed! For 42 years, Eagle Electric has manufactured electrical wiring devices designed to cut installation time, to lower costs, and to meet the most rigid specifications of QUALITY at fair prices.

Eagle places so much importance on QUALITY that special inspectors are employed to inspect the inspections of customary inspectors. This is a mammoth operation, when you consider that there are more than 1500 different items in the full Eagle line —a long, broad line by any standards.

You have to go a long way to match Eagle QUALITY . . . at any price.



**Electric Heat** (33)

A new line of baseboard electric convectors, designed as Circle-Air Safe-T-Shape, has been announced. The Safe-T-Shape makes it impossible for furniture or drapes to block the air intake or discharge louvers. They are available in 600-, 750-, 1000-, 1200-, 1500- and 2000-watt capacities in a choice of 120, 208 or 240 volts. Units are mounted directly to wall, with a maximum projection of 2½ in. Convectors are available with or without factory installed thermostats.

*Circle-Air Industries Inc.,* 244 *Herkimer St., Brooklyn* 17, *N. Y.*

**Transformer** (34)

A new pole-mounted distribution transformer is available in ratings to 167 kva. Model DO-65 employs a high temperature "Hypoxseal" insulation system which operates at 65°C average winding temperature. The system permits reductions in weight and size and provides greater life expectancy. Transformers feature a new wound core. Literature is available.

*Federal Pacific Electric Co.,* 50 *Paris St., Newark, N. J.*

**Pipe Wrench** (35)

A new threaded pipe wrench eliminates damage to fittings and pipe or nipple in make-up or extracting work. Patented action eliminates crushing and tension; and pipe wrench never touches pipe or fitting surfaces. Tool comes in sizes for work with pipe from ⅛-in. to 2-in. diameters.

*Brase Tool Co.,* 301 *Broadway, San Francisco, Calif.*

**Generator Set** (36)

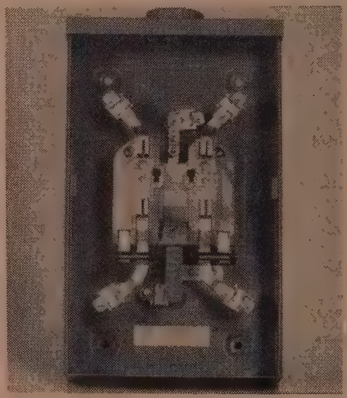
A new 1000-kw gas turbine generator set (LM175E) designed primarily for emergency back-up power generation has been announced. Its prime mover is an adaptation of the J85 aircraft jet engine. For this generating application, the J85 compressor was modified slightly; the number of stages was reduced, and a front drive shaft at the compressor end converted it to a single-shaft turbo-shaft engine. One of the applications for the LM175E is emergency standby power generation for telephone exchanges. A number of other applications are expected, including use in hospitals, missile bases, radar installations, airports, utility peaking, civil defense, and in other locations where loss of power could impair the public welfare.

*General Electric Co., Schenectady* 5, *N. Y.*

**Distribution Transformer** (37)

Introduction of its new Endur-All/65 pole-type distribution transformer in ratings from five through 500 kva designed to withstand full short-circuit has been announced. Reduced size comes from low-voltage aluminum sheet windings. Varnish-free core and coil assure improved over-all system impulse strength. Unit is designed for pole cluster-mounting. Larger clamp-type connectors are suitable for aluminum or copper cables.

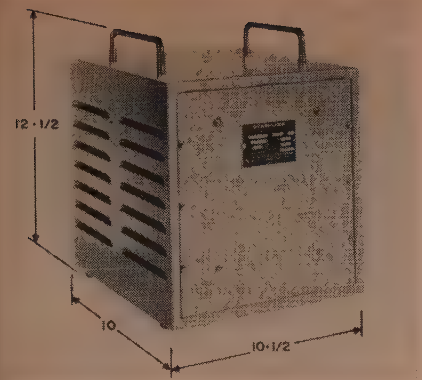
*Allis-Chalmers Manufacturing Co., Milwaukee* 1, *Wis.*



**Meter Mounting** (38)

A new 200-amp meter mounting has a built in by-pass that by-passes the meter so there will be no interruption of service to customer for replacement or test of meter. A twist of the wrist of the finger tab does the by-passing. When a building or residence needs service before a meter is set, the by-pass tab is turned to "up" position and a glass cover can be sealed on mounting. Meter cannot be sealed on mounting with it in by-pass position. There is ample wiring room. This same by-pass is also on 100-amp single and 100-amp gang type mountings.

*Code Corp.,* 4566 *Baker St., Philadelphia* 27, *Pa.*



**Voltage Regulator** **(39)**

New solid-state, semiconductor Stabiline automatic voltage regulator, designated Type XR2500, will maintain constant output voltage regardless of line or load changes. Basic design can be adapted to other voltage, frequency and load requirements but representative ratings are: input 95-135 volts, 45-70 cycles single phase; output 115 volts nominal, 110-120 volts adjustable, 2.5 rated kva.

*Superior Electric Co., Bristol, Conn.*

**Polarizing Panel** **(40)**

A new enclosing element for fluorescent lighting fixtures, employing an improved method of polarizing light, has been announced. Panel gives 45% polarization and it is designed for standard installation in offices, stores, schools and other buildings. The panel consists of tiny glass flakes arranged in layers in a polyester plastic sheet. Panel is available in four sizes: 1 by 2 ft, 1 by 4 ft, 2 by 2 ft, and 2 by 4 ft. It fits Day-Brite's standard troffer, Mobilex and Daylume fixtures, and will be offered as an optional enclosure for these fixtures. It will also be offered for existing Day-Brite fixture installations using the above units.

*Day-Brite Lighting, Inc., 6260 N. Broadway, St. Louis 15, Mo.*

**Pushbutton Stations** **(41)**

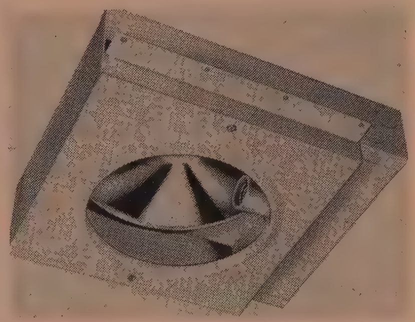
An improved series of heavy-duty electrical pushbutton stations which will replace the present D-120 and D-113 series of standard and heavy-duty models, has been introduced. The new series, designed primarily for use with magnetic motor starters, consist of a D-11 single-circuit universal model, a D-12 double-circuit universal unit, and a D-13 start-stop station. The D-11 series has a 600-volt ac maximum rating, is UL listed for heavy-duty use, and meets NEMA standards. They can also be used with low-voltage ac across-the-line magnetic starters, and reduced-voltage ac general purpose magnetic starters using 150-amp and smaller line contactors. New stations will also replace modified versions of D-113 and D-120 Series used for OFC, EGP and EWC explosion-proof pushbutton station enclosures. EFD, EFS, FS, FD, EGP, OFC and EWC pushbutton station Condulets will all be equipped with the new D-11 models.

*Crouse-Hinds Co., Syracuse, N. Y.*

**Fittings** **(42)**

New fittings for use with the latest types of jacketed interlocked cable, both jackets and non-jacketed continuous armored cable are now part of this complete standard line. Fittings are immediately available in 15 basic types both in cast aluminum as well as bronze to parallel the standard line of terminators and splicing fittings for interlocked armored cable. Literature is available.

*OZ Electrical Manufacturing Co., 207 Bond St., Brooklyn 17, N. Y.*



**Housings** **(43)**

Heavy duty concrete power housings for 60-, 100- and 150-watt lamps are now available. Units are designed for top access to junction box for wiring before pouring and for inside access for wiring after pouring. Housings are made of 16-gauge steel that has been enameled and baked. Both prewired and unwired housings feature extra shallow depth of only 3½ in., and specially designed reflectors. Openings of from 7⅜ in. sq, 9½ in. sq and 11¾ in. by 11¾ in. sq indicate range of housings for 60- to 150-watt lamps. A variety of trim frames and glass enclosures of opal, fresnel and louvered are available. Literature is available.

*Markstone Mfg. Co., 1531 North Kingsbury St., Chicago 22, Ill.*

...for example:

NEW EAGLE Smooth Line WALL PLATES

- Sleek, jet-stream design
- Specification Grade
- 11 popular styles
- Fit all wall plate applications

Clean design in a handsome, durable wall plate—that's new EAGLE "Smooth Line". Non-inflammable, heavy brown bakelite and ivory urea plates meet every residential, commercial, industrial, institutional application. Write for literature.

EAGLE

EAGLE ELECTRIC MFG. CO., INC.
[illegible]
"Perfection Is Not an Accident"

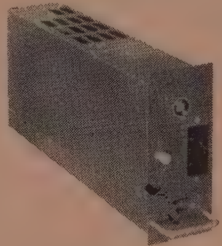
*Lighting News*

AT THE **ACADEMY OF MUSIC OF PHILADELPHIA**

...another installation by **KLIEGL**

Fifty years after installing its original Kliegl system, the Academy of Music has again called on Kliegl for the latest in switchboard design. Its SCR® Dimmer Board, specified by W. A. MacAvoy, Jr., lighting consultant, is a new, years-ahead system employing 72 6KW dimmers with all fingertip controls compacted into a 38-inch width for convenient, flexible operation.

No matter how different or difficult your lighting problem, *Kliegl can provide your solution!* Kliegl recommendations are backed by more than a half-century of experience in optics design and lighting application. They are based on thousands of installations developed for hundreds of architects, designers and engineers. Take a tip from the lighting leaders — for your smallest-to-largest projects, call on your Kliegl representative. Or, write us directly. You stand to gain *more* in time, money, satisfaction.



**Kliegl SCR Dimmer** — the most modern, method yet devised to obtain **completely stepless** control of light intensity.

**Our lighting advisors will be pleased to assist in the planning of any installation, using standard or special units to meet your requirements. Full details on request.**

lighting

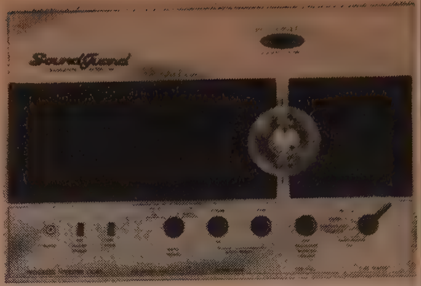
**KLIEGL BROS.**

ORIGINATORS AND MANUFACTURERS OF KLIEGLIGHTS

**321 W. 50th ST., NEW YORK 19, N. Y.**

Telephone: Area Code 212, COlumbus 5-0130

2-330



### Intercom System (44)

A completely transistorized intercommunications system combined with AM-FM radio is now available for both home and office with the sound guard director, Model SG-8407. System includes: master station, three indoor remote stations, and one outdoor remote station. Like all Sound Guard Radio Intercoms, the Director requires the SG-8400 recess installation kit consisting of housings, wire and mounting brackets.

*Progress Webster Corp., Rochester 21, N. Y.*

### Heating Units (45)

A new line of electric infrared heating units has been introduced. They are designed for indoor or outdoor use. Objects are heated directly by infrared rays. Some of the areas with large air movements that might use infrared units would be: airplane hangars; airport, railroad and bus terminals; building entrances, marquees and vestibules; drive-in establishments; garages and service stations; grandstands; loading platforms; maintenance shops; patios and outdoor cafes; swimming pools; and transit platforms. Literature is available.

*Ilg Electric Ventilating Co.,* 2850 *North Pulaski Road, Chicago* 41, *Ill.*

### Drills (46)

A new line of heavy-duty ½ in. all-purpose drills that has the compactness of ¼ in. units and advantages of right-angle drilling, plus power, torque and speeds to handle general and specialized heavy-duty jobs, has been introduced. Drill is also 3⅜ in. wide and fits into narrow places. For awkward, close-quarter jobs, spade handle is removable. Model No. 723 is a reversing drill for safely backing out of tight spots or heavy timbers, especially when operator is in a precarious position.

*Stanley Power Tools, division of Stanley Works,* 195 *Lake St., New Britain, Conn.*

### Motor-Alternator Set (47)

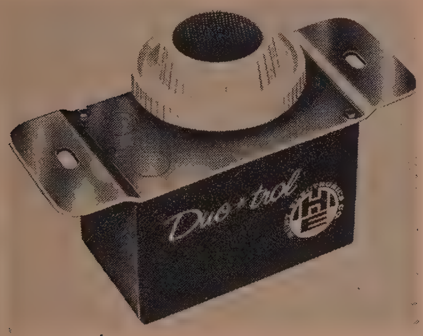
A portable motor-alternator set that plugs into any standard 115-volt outlet and converts 115-volt, 60-cycle, single-phase power to 400-cycle, single- or 3-phase power is available. Basically designed for powering or testing 400-cycle equipment, output may be rectified for use on dc equipment. Set consists of a ⅛-hp induction drive motor and a permanent magnet 14-pole alternator.

*General Electric Co., Schenectady 5, N. Y.*

### Transformer (48)

A new dry-type transformer with a 3-piece case, called the Atlantic "3," has been introduced. It has been designed to simplify installation. It is ideal for use at many indoor sites formerly considered unsuitable for conventional transformers. It provides an extremely reliable power supply for equipment, assembly line machinery, appliances, lighting loads and an infinite variety of low voltage applications. It is available in single phase ratings from 3 to 25 kva, Class B, 80° C rise. Literature is available.

*Atlantic Transformer Co., 8330 Hegerman St., Philadelphia 36, Pa.*



### Light Dimmer (49)

A new light dimmer, called the Duo-Trol 600, has been introduced. Rated at 600 watts, it electronically controls all incandescent lighting fixtures from any standard wall box without special wiring or separate attachments. Duo-Trol 600 is a solid-state, full-wave proportional power control which conserves power in exact proportion to the light intensity used. One of the features is the combination tap/dial which may be tapped on and off at any pre-dialed light level. Another is the short-stroke continuous control potentiometer.

*Hunt Electronics Co., 2617 Andjon Dr., Dallas 20, Texas.*

TAKES THE HARD WORK OUT OF WIRE PULLING

- up to 62% more "slip" than other compounds
- works best where the pulling is toughest, bends are tightest
- for all wire sizes including 500 MCM and larger
- harmless to hands, plastic or rubber insulation
- use it to "zip" wires through steel, fiber, or aluminum conduit
- unharmed by freezing, won't dry out in the can

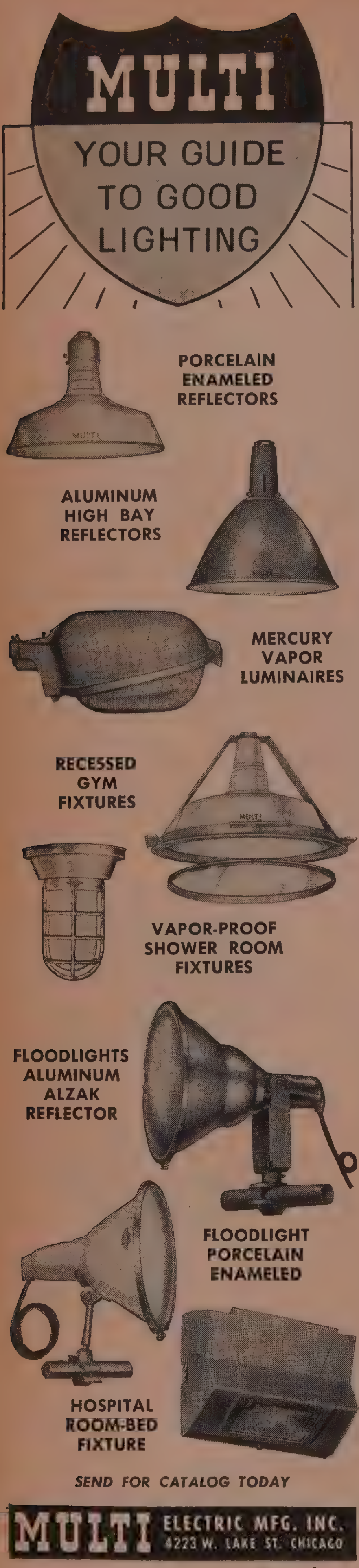
Available in quart and gallon cans, 5-gal. pails, 55-gal. drums

**YELLOW 77** is a creamy textured compound with a wax base. Special additives make it form a slippery film all along the wire and conduit . . . *doesn't quit half way through . . . won't wash off in water.* Waxy film stays on so wires slip out easily, if ever necessary later. Quickly applied by hand, brush or cloth . . . isn't messy . . . smells good . . . safe! Free Contractor's Catalog gives all facts . . . get it *now* — send coupon . . .

**IDEAL INDUSTRIES, Inc.**
1041-H Park Ave., Sycamore, Ill.
Please send me free Contractor's Catalog containing details on Yellow 77

SOLD THRU AMERICA'S LEADING DISTRIBUTORS
In Canada: Irving Smith, Ltd., Montreal

Name____________________
Company____________________
Address____________________
City__________ Zone____ State________


MULTI
YOUR GUIDE TO GOOD LIGHTING
PORCELAIN ENAMELED REFLECTORS
ALUMINUM HIGH BAY REFLECTORS
MERCURY VAPOR LUMINAIRES
RECESSED GYM FIXTURES
VAPOR-PROOF SHOWER ROOM FIXTURES
FLOODLIGHTS ALUMINUM ALZAK REFLECTOR
FLOODLIGHT PORCELAIN ENAMELED
HOSPITAL ROOM-BED FIXTURE
SEND FOR CATALOG TODAY
MULTI ELECTRIC MFG. INC. 4223 W. LAKE ST. CHICAGO

### Extension Saw (50)

A new hole cut extension saw is especially designed to drill, guide and cut holes for service entrance, pipe riser, through the roof overhang and pitched roof, all in one or two minute operation. Saw begins with a special automotive length (6⅜ OAL) high speed steel drill which projects 2½ in. beyond and above cutting edge, for easy starting and deep pilot hole on steep pitched roofs. Coarse tooth, high speed steel deep cut saws are screwed onto the ⅝-in. stressproof alloy steel nose which is threaded ⅝-18 to receive any standard hole saw. The nose without guide tubes will clear a 1-in. hole.

*Blackhawk Industries, Dubuque, Iowa*

### Wall Plate (51)

Duplex weatherproof wall plates feature stay-open individually hinged covers. Plate is constructed of corrosion resistant aluminum, .060 in. thick and will accommodate all types of standard flush tumbler and power outlet combinations. Covers, hinged to plate with stainless steel spring and aluminum pin, are of aluminum coated die-cast zinc and include cemented-in soft rubber gasket for weather-tite fit. Recess in covers provide clearance for switch handles in either "off" or "on" position.

*Leviton Manufacturing Co., Brooklyn* 22, *N. Y.*

### Substations (52)

A redesigned line of single-circuit unit subtations has been announced. They are available from 1,000 to 7,500 kva, and include a dual-rated 55C/65C transformer and a feeder drawout power circuit breaker, with necessary auxiliary devices. New "close-coupled" design permits transformer and switchgear compartment, which is bolted to common base, to be moved separately. The change from previous "wrap-around" design makes it possible to enter switchgear compartment from either front or back.

*General Electric Co., Schenectady* 5, *N. Y.*

### Temperature Element (53)

A new room temperature indicating-controlling element designed for mounting on ceiling-type aspirating grilles or diffusers is available. Mounted in aspirated air representative of room temperature, the element gives immediate electronic response for automatic control, indication or indicating control. A 3-ft flexible conduit terminating in a ½ in. connector is standard. Unit may be mounted on circular Venturi-Flo diffusers, louver face, or perforated face diffusers. Element is furnished in 1000, 500 and 33 ohm resistances.

*Barber-Colman Co., Rockford, Ill.*

## Product Briefs

(54) Utility Body Co., Oakland, Calif., has introduced a new Series E enclosed superstructure **truck body** with a new weatherproof telescopic steel roof.

(55) General Electric Co., Wiring Device Dept., Providence, R. I., has introduced a redesigned FS-400 "Watch Dog" **starter** employing a new metal glow switch. . . . (56) A lightweight ½-in., pistol-type **drill**, designed for heavy-duty industrial and construction work, has been introduced by Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.

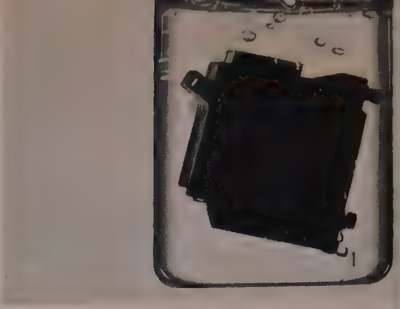
(57) Skil Corp., Chicago, Ill., has announced a new heavy-duty, ⅜-in. electric **drill**, Model 262, which has a 4-amp motor, all ball and needle bearing construction and a lightweight die-cast aluminum housing. . . . (58) New compact "handy" **boxes** manufactured to oiltight JIC standards are now available from Keystone Mfg. Co., Warren, Mich.

(59) NuTone, Inc., Cincinnati, Ohio, announces new wall **fans** available with all-aluminum exterior parts. . . . (60) Bi-Cast TD-2 epoxy **compound kits** for splicing, terminating and repairing of paper-lead cables are now available from the Bishop Mfg. Corp., Cedar Grove, N. J.

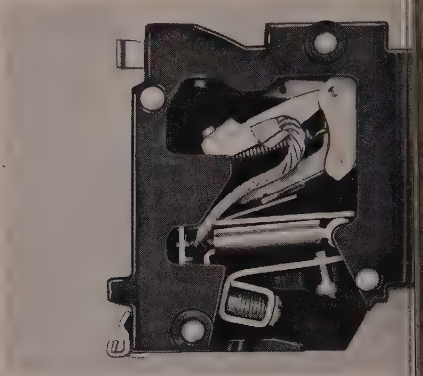
(61) Thomas & Betts Co., Inc., Elizabeth, N. J., has added a new ½-in. diameter pre-insulated service entrance **splicer** to their line of insulated and non-insulated service entrance splicers for residential and commercial installations up to No. 1/0 conductor.

(62) New Porter-Cable "Kango" L, K and M type electric **hammers** designed for all kinds of industrial, commercial and building construction uses, have been introduced by Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.

WHAT A BEAUTIFUL WAY TO SHOW HOW GOOD YOUR WIRING JOB IS
CONTROL
CUTLER-HAMMER



**WON'T RUST, WON'T CORRODE.** Ever operating part is either stainless ste or heavily plated for rust and corrosio resistance.



**DOUBLE PROTECTION.** Both magneti trip for short circuits and a bimeta trip for sustained overloads.

*Looks so much better, installs so much easier . . .*

# Cutler-Hammer's NEW Safetybreaker*

*. . . far ahead in every way*

Here's a bonus in beauty and protection that gives you—and your homeowner customer—many exclusive features at *no extra cost.*

Why install the old-fashioned "basement gray" box when this modern appliance styling is available for the same—often lower—price?

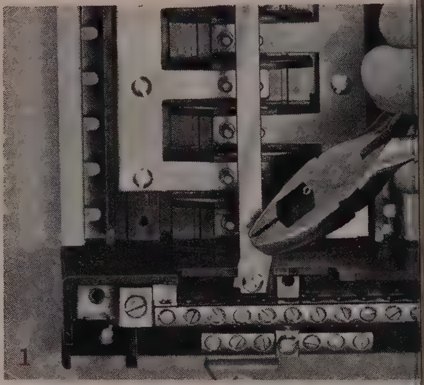
---

*Simplest, most foolproof non-interchangeability system by far*

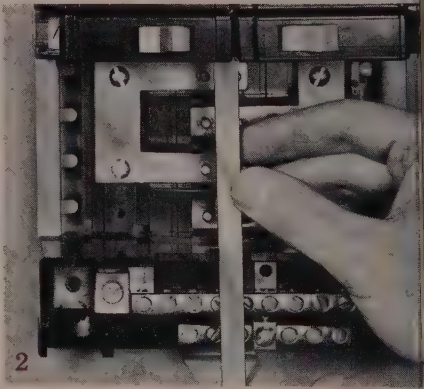
Safetybreaker's simplified non-interchangeability is as far ahead of competition as its styling. There's no fussy keying system. No special tools or "can openers" are required. It's impossible to break off or incorrectly position tabs. See your Cutler-Hammer distributor for a 60-second demonstration. Try it. Prove to yourself how much better, how much easier to install the Safetybreaker is.

*Here's how the simple "up-down" N. I. system works:*

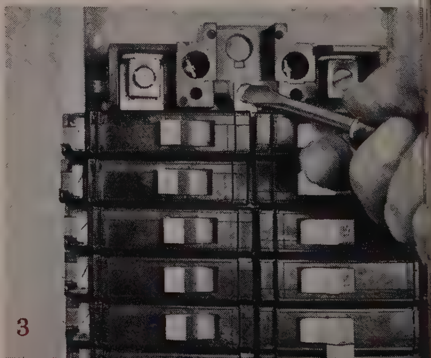
1. Tear off plastic spacers to loosen locking bar screws, and let locking bar drop.
2. Plug in breakers in top portion of panel. Slide bar to top of panel.
3. Plug in remaining breakers. Tighten two special screws to lock the N. I. system. That's all there is to it!



1



2



3

CONTROL

**CUTLER-HAMMER**

*Cutler-Hammer Trademark

# Catalogs & Bulletins

(63) TOOL WIRE. Bulletin 2152 describes new Okoseal 200 industrial and machine tool wire, a flame-resistant polyvinyl-chloride (PVC) insulated, single conductor wire rated at 600 volts. Okonite Co.

(64) MOTORS. Bulletin 420.4, fifth in a series of bulletins and specification sheets, covers ac special application motors for lightweight tools, commercial appliances, and business machines. Large Motor Div., Robbins & Myers, Inc.

(65) HEAT PUMP instruction brochure contains suggestions on the removal and installation of refrigeration valves, as well as procedures of determining operational difficulties. Chatleff Controls, Inc.

(66) INTERCOM. Brochure introduces the sound guard director, a transistorized intercom with AM-FM radio. Progress Webster Corp.

(67) JET PUMP MOTORS. GED-4361 discusses combination ball and sleeve bearing construction which gives new jet pump motors advantages of both bearing systems. General Electric Co.

(68) LIGHTING. Complete catalog illustrates low-voltage and standard spotlights; all types of specialty lighting adapters and accessories, including glass color filters. Lighting Services, Inc.

(69) ELECTRIC HEATING. 24-page catalog on 1962 line of permanent electric heating equipment includes descriptions on new wall heaters, ceiling heaters, baseboard units, control and snow melting equipment. Arvin Industries, Inc.

(70) MOTORS. Bulletin 10561 describes applications of torque motors and brakes, multipolar motors and 400-cycle motors for the machine tool, plastic, chemical, textile and food processing industries. B. A. Wesche Electric Co.

(71) MOTORS. 12-page Bulletin F-1856 on the U. S. uniclosed motor, Type H, contains information on new motors, including the recently released "1000" Series motors in dripproof, totally enclosed and explosion-proof designs. U. S. Electrical Motors Inc.

(72) WIRE AND CABLE. 83-page catalog describes 143 types of wire and cable. American Insulated Wire Corp.

(73) ELECTRIC FURNACE. Literature explains their ducted-air electric heating system and electric furnace line. Mueller Climatrol, Div. of Worthington.

(74) STANDBY LIGHTS. 8-page catalog describes battery-powered standby lights and a complete line of accessories. Watchmaster Div., Carpenter Mfg. Co.

(75) TRANSFORMERS. 12-page Bulletin GEA-7692 gives detailed information on the application, construction and operation of new line of single-phase pad-mounted distribution transformers for underground residential distribution systems. General Electric Co.

(76) LIGHTING. Outdoor wall and surface-mounted lighting units for commercial, industrial and residential applications are described in 8-page Bulletin WE 2-362. Art Metal Lighting Div., Wakefield Corp.

(77) ALUMINUM JOINING covering inert-gas welding, arc-welding, brazing and soldering methods is covered in 40-page illustrated manual. All-State Welding Alloys Co., Inc.

(78) TIME CONTROLS for automated electrical operation geared to a daily "on-off" scheduling are described in Bulletin 6218. Paragon Electric Co., Inc.

(79) LIGHTING. 44-page catalog presents expanded line of incandescent and fluorescent lighting fixtures designed for both residential and commercial installations. Markstone Mfg. Co.

(80) SWITCHGEAR BATTERY MAINTENANCE. An easy-to-follow formula to maintain switchgear control electric storage batteries at peak operating condition is contained in 4-page article entitled "How to Maintain Switchgear Control Batteries." Exide Industrial Marketing Div., Electric Storage Battery Co.

(81) CONNECTOR. 4-page Data Folder 6205 describes the new Rib-Grip compression connector. Jasper Blackburn Corp.

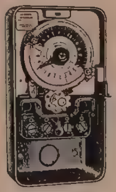
(82) AC SWITCHES. Booklet discusses design, construction, operation and application of ac switches and includes a Switch-Finder chart. Harvey Hubbell, Inc.

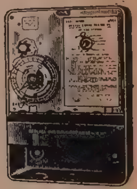
(83) SILICON BATTERY CHARGERS, constant current chargers, and end-cell chargers are described in 6-page Bulletin 4-100. Raytheon Co.

need a
TIME SWITCH
to provide cost-cutting automatic control of Lighting, Heating, Ventilating and Air Conditioning Equipment in:

FACTORIES • CHURCHES
APARTMENT BUILDINGS
OFFICE BUILDINGS
PUBLIC BUILDINGS
• SCHOOLS •

7000 Series


4000-S Series


47007-0SZ Series

PARAGON
makes it!

Choose from Paragon's complete line—offering the right control, the exact switching mechanism and capacity for practically any application.

For complete information **contact your Authorized Paragon Distributor.** He carries a full line in stock and is qualified to provide technical assistance if needed.

PARAGON
WHOLESALE POLICY
We sell Paragon Time Controls to dealers, contractors and industrial end users ONLY through our established Wholesalers Paragon does not depart under any circumstances, from this policy — firmly held for more than 50 years

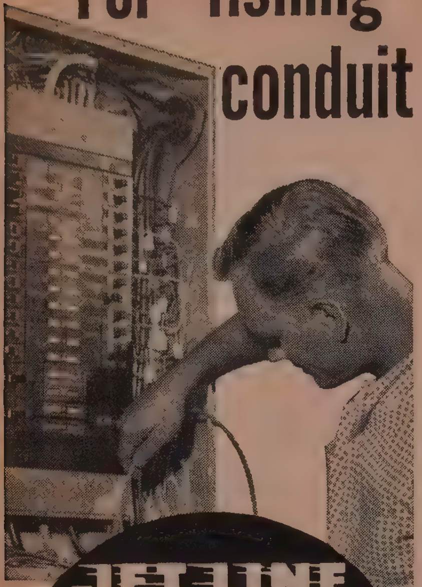
Call for Paragon on *your* next order.

27704A

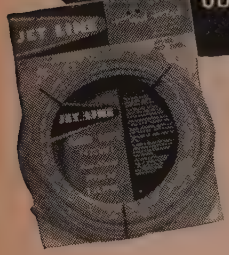
AmF
PARAGON ELECTRIC CO., INC.
Subsidiary of American Machine & Foundry Company
1614 TWELFTH STREET • TWO RIVERS, WISCONSIN

*Time is money... control it with Paragon*

For "fishing" conduit



JET LINE®
NON-CONDUCTIVE
Rigid Rope*
makes metal fish tape obsolete

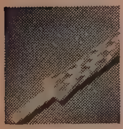


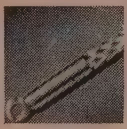
NOW—with RIGID ROPE—fish any 1/2", 3/4", 1" conduit faster, safer, for less cost!

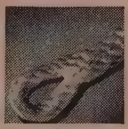
- **Greater rigidity**—tightly braided jacket over improved core. Non-conductor!
- **Strong**—withstands one or two man pull.
- **Affords excellent grip**—never cuts even when wrapped around hand.
- **Lightweight**—14 oz. per 50 ft. Available in 50′ and 100′ lengths.

RIGID ROPE costs less than any metal tape designed for use in all types of conduit. (Polyethylene "Guide Sleeve" for outlet boxes included.)

*Patent Pending


New improved core


New metal eye


Non-conductive loop

**Connect wire at either end!**

*For full information on RIGID ROPE, and the complete Jet Line Method of wiring conduits, ask your distributor or write*

JET LINE® PRODUCTS, INC.
305 Foster Ave.
Charlotte 3, N. C.

5916

(84) LIGHTING. "General Lighting Design," 16-page booklet, contains basic information about the "lumen" method of lighting design, used to determine the number of lamps and fixtures required to obtain given footcandle levels in rooms of various sizes and reflectances. General Electric Co.

(85) SCHOOL LIGHTING. Brochure describes Ortho lighting system for classrooms. Gibson Mfg. Co.

(86) COMMERCIAL LIGHTING catalog and specification guide for commercial and industrial lighting fixtures describes a wide variety of decorative and functional fixtures. John C. Virden Co.

(87) TERMINAL BLOCKS, terminal strips, special connectors and accessories are described in new catalog. Rowan Controller Co.

(88) LIGHTING POLE Catalog L-7 of tapered aluminum standards for all outdoor lighting applications describes lighting for street, highway, residential, patio, pool, marinas, motels and parking lots. General Tapered Products, Inc.

(89) SUBSTATIONS. New line of pre-engineered secondary unit substations, available for 4.16, 12.0, 13.2 and 13.8 kv applications, is described in 8-page Bulletin 3110-1A. I-T-E Circuit Breaker Co.

(90) FLUORESCENT LIGHTING. Two new sizes of "Sabre" fluorescent lighting fixtures, meeting virtually all lighting requirements of schools, offices and stores, are described in 4-page brochure. Miller Co.

(91) MOTORS. New specification sheet for users of special purpose fractional hp motors covers the squirrel cage induction, ball bearing type for both conventional and explosion-proof applications. Motor Appliance Corp.

(92) INDICATOR LIGHTS. Brochure presents technical data on Dialco indicator lights designed for applications requiring lights that are completely oil-tight, water-tight and dust-tight on the face of the panel. Dialight Corp.

(93) MOTORS. 20-page Bulletin F-2055 covers the major lines, services after sale, and facilities and information on types of standard and specialized motors and allied products. U. S. Electrical Motors Inc.

(94) SILICONE VARNISHES. 6-page Brochure 07-009 entitled "Silicone Varnishes for Dipping, Impregnating" describes four varnishes f use at AIEE Classes 180 and 220 and two for use at temperatures b low Class H. Dow Corning Corp.

(95) POWER SYSTEMS. Bullet 6639 describes circuits and cha acteristics of completely stat systems that provide standby electrical power for variety of a plications. Exide Industrial Marke ing Div., Electric Storage Batte Co.

(96) TRANSFORMERS. Bulleti 61C9696A features "Safe/Tra 3-phase padmounted transforme suited for apartment houses, sho ping centers, schools, hotels, motel theatres and industrial park Allis-Chalmers Mfg. Co.

(97) CONNECTORS. Brochure d scribes color-keyed compressio connectors and catalogs the diffe ent sizes in five basic categories— one-hole and two-hole lugs, splice compression taps and pigtail Thomas & Betts Co., Inc.

(98) EXPANSION BOLT. The Wej-i method of anchoring anything t concrete and other nonfrangibl materials is described in Dat Sheet No. 462. Wej-it Expansio Products, Inc.

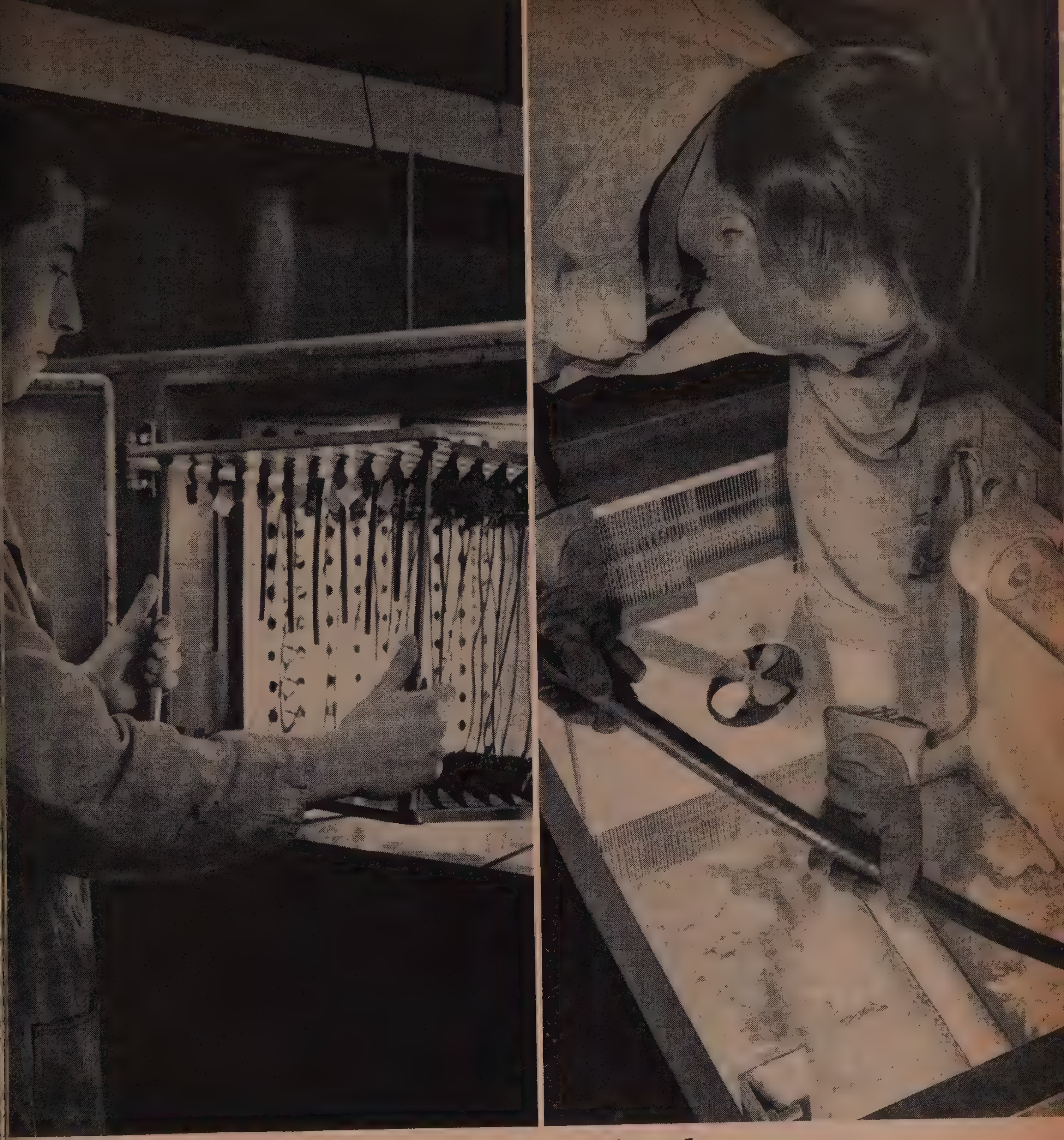
(99) MOTOR CONTROLS. 12-pag catalog covers specifications of al major products including magneti starters and contactors; reversin starters and contactors; reduce voltage and manual starters. C. an E. Automatic Products.

(100) GARDEN LIGHTING. Flowe beds, trellises, fountains, pool walkways, drives, barbeque or rec reational areas can now be enjoye by night as well as by day whe illuminated with the Floralites de scribed in brochure. Steber Div. Pyle-National Co.

(101) MOTORS. Technical Bulleti F-2030 provides ratings, dimensions, specifications and a selec tion guide for the various products in Syncrogear line. U. S. Electrical Motors Inc.

(102) TEST KIT. The "Mark III" conductivity test kit used to measure the conductivity of floors and other equipment in anesthetizing or other critical areas is described in Bulletin 21-752-6. James G Biddle Co.

(103) POWER SUPPLIES. 32-page brochure describes approximately 500 models from complete line of standard Sorensen controlled power products and custom capabilities. Sorensen Products, Raytheon Co.



*Hot and cold cable torture chambers…*

**mean better cable for you.** Our aim at Circle is not just to meet specifications, but to see how far we can exceed them. This is the job of our cable testing laboratory.

High temperature aging . . . sub-zero freezing . . . ozone . . . long-time water immersion . . . and many other tests are performed continuously to assure maximum cable reliability. Add to this Circle's unmatched manufacturing experience and reputation for fast service and you'll see why Circle is the choice of so many cable users. For better cable at no extra cost specify Circle cable on your next job.

C
W C

**CIRCLE WIRE & CABLE CORP.**
SUBSIDIARY OF **CERRO CORPORATION**

**PLANTS:** Maspeth and Hicksville, N. Y. **SALES OFFICES & WAREHOUSES:** In all principal cities.
Rubber Covered Wires & Cables • Varnished Cambric Cables • Plastic Insulated Cables • Neoprene Sheathed Cables • "CIRTUBE" EMT

# COMPLETELY BUSSED TO GO UP QUICK!

# I-T-E METERING SYSTEMS

# SAVE UP TO 70% IN TIME

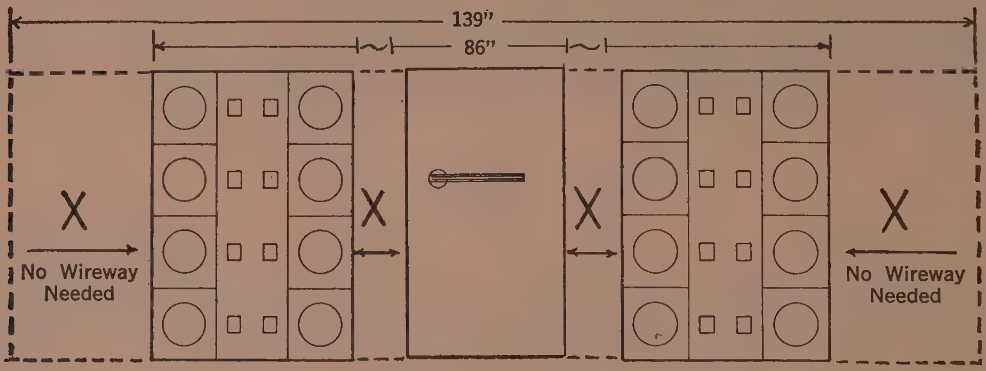
**I-T-E METERING SYSTEMS** are complete devices! I-T-E does the bussing in the factory so you don't have to wire on the job! Only two major components to connect — main disconnect and meter-breaker section. The elimination of separate wireways means faster installation and more meters in less wall space. Complete bussing also assures **lower total cost.** You merely wire in service to the main disconnect . . . and wire out distribution from the breakers.

Wall mounted meter centers are available for services through 600 Amps. Free standing island type meter centers are available for services through 2000 Amps. Installations from the smallest up to 100 **or more** meters are no problem with these superior designs.

**DESCRIPTIVE BULLETIN AVAILABLE!**

For additional information on famous-quality I-T-E Metering Systems, ask for Bulletin 9001 from your I-T-E Authorized Distributor, local I-T-E District Office, or write to I-T-E Circuit Breaker Company, 125 Bennett St., N. W., Atlanta 9, Ga.

***for the Contractor who is Proud of his work***



**I-T-E CIRCUIT BREAKER COMPANY**

**WALKER DIVISION**

# Reader's Quiz

**QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.**

## Multiple Neutral Grounding

*QUESTION G41—We have recently encountered a rather interesting problem in the design of a power distribution system. We submitted to a client the design of a 3-phase, 4-wire distribution system with the neutral grounded at the transformer, but the neutral was not grounded at the individual power and lighting panels. The entire plant structural steel was bonded and adequately grounded.*

*However, they insisted that the neutral be grounded at every power and lighting panel.*

*Will someone please explain the advantages or disadvantages of the method required by our client. Further, what is the current trend in this area?—J.A.M.*

ANSWER TO G41—Section 250-23 of the 1959 NEC spells out the requirements for grounding connections for alternating-current systems. The code states that no connection to a grounding electrode shall be made to the grounded circuit conductor on the load side of the service disconnecting means, except as provided for in Section 250-24 (which applies to two or more buildings supplied by a single service).

In addition, Section 250-21 states, "The grounding of wiring systems, circuits, arresters, cable armor, conduit, or other metal raceways as a protective measure shall be so arranged that there will be no objectionable passage of current over the grounding conductors. The temporary currents set up under accidental conditions, while the grounding conductors are performing their intended protective functions, are not to be considered as objectionable. . . ."

By grounding the neutral at every panelboard, the neutral currents are given three parallel paths of return to the source:

a) via the cable armor or conduit

b) via the building structural steel

c) via the neutral conductor.

Under normal conditions most of the neutral current would flow through the neutral conductor because of its much lower inductive reactance with respect to the phase legs. However, some current would also flow on the conduit or cable armor, and a small percentage would flow on the structural steel. The two latter current flows are in direct violation of Section 250-21 of the code.

If a neutral of a panelboard feeder were to become "open" or disconnected, most of the neutral current would then return via the cable armor or conduit. This path could have a sizable impedance, thereby raising the potential of the panelboard housing with respect to ground. This difference of potential would create a dangerous shock hazard. In addition, any grounded conductive object making intermittent contact with the return path of this neutral current could cause an arcing condition which would create a fire hazard.—S.L.P.

## Treating Insulation Boards

*QUESTION H41—In our plant, we have small power packs which generate about 8000 volts direct current for static precipitators in our air conditioning units. The tubes and other electronic components are mounted on insulating board, which lately has become conductive. Discharge between the high-voltage tube sockets and other devices and the grounded metal case is taking place and the precipitator grid does not receive the full voltage.*

*Is there any way to treat the insulating board to establish the original insulating value?—E.C.T.*

ANSWER TO H41—Replacement of the insulating base would be the best way to repair the insulation damage caused by high-voltage leakage. The rectifier tube sockets should be checked for insulation breakdown and replaced if necessary.

Corona, a kind of high-voltage leakage that often causes permanent insulation damage in high-voltage circuits, can be eliminated by the following steps. First, the high-voltage compartment area should be cleaned to remove dust and moisture. Second, sharp-edged metallic points in the wiring and one the tube socket terminals should be removed by filing or cutting. Next, an anti-corona material should be sprayed around the corona area. As a final check, the lead dress of the high-voltage wiring should be examined for proper spacing and insulation from the grounded metal case.—K.C.

ANSWER TO H41—Disconnect the unit. Clean and inspect the insulating board. In case of arcing, the board may likely have been carbonated and must be discarded. In case of light corona, however, the board needs only cleaning. A spray of high-voltage acrylic ignition spray as used on ignition systems for cars or by TV servicemen may restore the original condition. —K.H.

## Faraday Shield

*QUESTION J41—What is a Faraday shield and how is it used?—J.B.K.*

ANSWER TO J41—A Faraday shield is a group of parallel wires used to isolate or control the electrostatic coupling to an electrical component, such as a resistor, coil, or circuit. One end of each parallel wire is connected to a common conductor so as to form a comb-like shield. The common conductor is usually grounded. The group acts as an electrostatic shield, but has little effect on the magnetic field since there are no closed loops around which eddy currents can flow.

The Faraday shield is more commonly used in radio transmitters and electronic measurements where its properties are useful. It sometimes is used in power transformers to isolate primary and secondaries electrostatically while still permitting magnetic coupling. In this application the shield may consist of a single turn of metal foil with a suitable gap to prevent the shield from acting as a short cir-

WESTINGHOUSE ASKED:

# "Why install more than you need?"

## and modernization costs went down

Recommendations by Westinghouse saved money for both owner and contractor on the modernization of the 250-room Seneca Hotel, Columbus, Ohio.

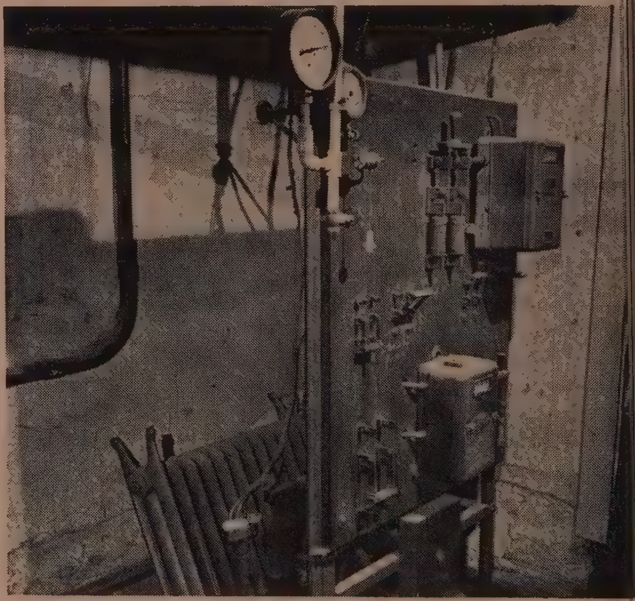
The 47-year-old hotel had fallen behind the times when it was bought by Seneca Realty, Inc., in April, 1961. The newspaper story caught the eye of V. J. Weisenbach of Electric Power Equipment Company. Mr. Weisenbach, who works full-time on modernization business, promptly proceeded to sell modernization beginning with central air conditioning and the electrical distribution system.

Westinghouse participated in the modernization, tailoring equipment recommendations to fit the job requirements. For example, original planning called for a 40-kw rectifier to supply power to the elevators. Westinghouse engineers analyzed the specs and suggested that a 25-kw unit would be more than adequate. On the regenerative control, tests were conducted to make sure this control was adequate for the installation.

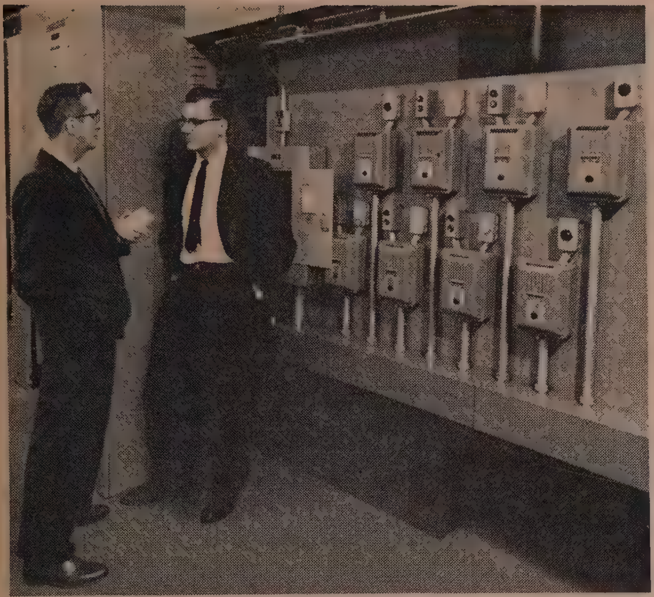
Today, Seneca Realty, Inc., saves $25,000 in maintenance and utility cost annually as a result of the modernization.

Westinghouse

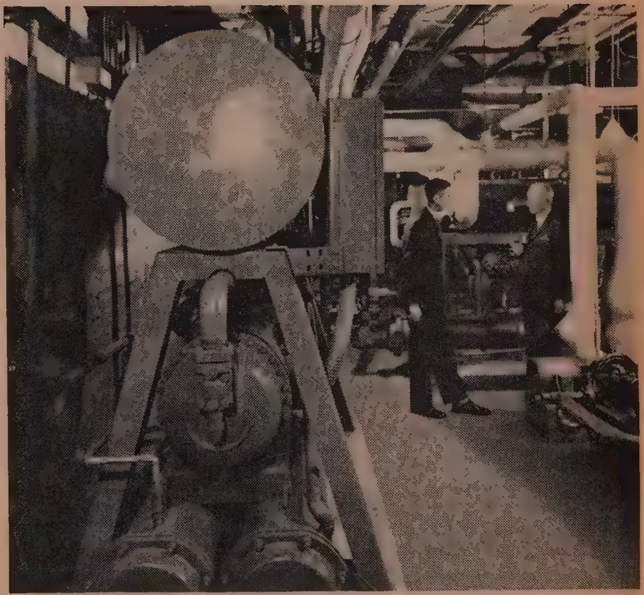
**Old.** Antiquated equipment in the boiler and mechanical roo before the modernization project. Almost inoperative equ ment was worn, dirty, in some cases unsafe. Maintenance w extremely difficult and often costly.



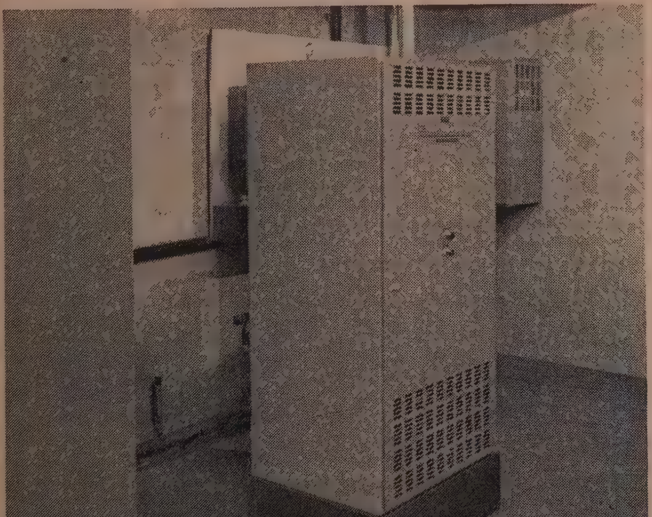
**Old.** The DC power for the hotel elevators was originally f nished by the utility. Switchboard open-live front was obvious personnel hazard. Controls were susceptible to du and dirt, requiring repeated maintenance.



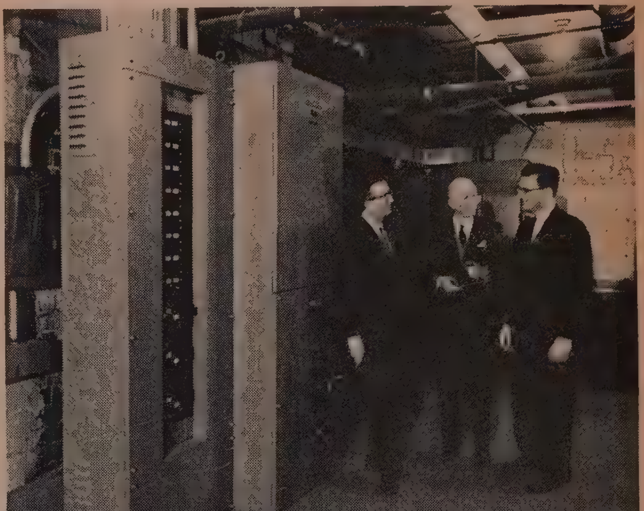
**New.** New Ⓦ Motor Control equipment discussed by V. J. Weisenbach, Electric Power Equipment Co., and W. B. Mann, Ⓦ Sales Engineer. Behind Mr. Mann is a new NQP Panelboard to feed lighting circuits. At right are size 1, Life Line® Starters that control pump and cooling motors.



**New.** Pictured are Mr. Sam Shuman, President, Julian Speer Co., Mechanical Contractor, and Herbert Tareyton, V. P., Seneca Realty, Inc. In left foreground is Ⓦ PKB packaged water chiller providing air conditioning for every room of the Seneca Hotel. The unit is provided with a complete control panel, factory-wired and ready for connection. Large hotel guest room closets house Ⓦ Series 1601 Air Distributing units, manufactured by the Sturtevant Division of Westinghouse.

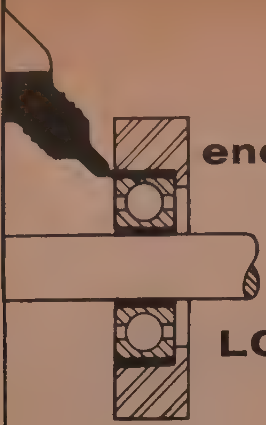


**New.** With local utility discontinuing DC service, the economical answer was this Ⓦ 25-kw Silicon Rectifier furnishing Seneca elevators with DC power. The compact, fan-cooled unit is a maintenance-free static device. Regulation and control are automatic. The panel mounted on the wall behind the unit controls regenerative power for down elevators.



**New.** Messrs. Weisenbach, Tareyton and Mann stand alongside the new Ⓦ Building-type Switchboard which handles incoming 120/208V power. This Series I Switchboard houses all protective devices in one dead front streamlined enclosure. The Distribution section feeds and protects auxiliary circuits in the equipment room.

J-94191



**Loose-fitting end-bell bearings easily repaired with LOCTITE sealant**

2¢ worth of LOCTITE sealant, "the Liquid Shim," restores bearing fits in electric motor end-bells without machining. Just a drop or two of LOCTITE sealant on bearing and housing does the job in minutes. Eliminates need for reboring, sleeves, shims, metallizing. Bearings mounted with sealant can be removed with ordinary bearing removal tools. Comes ready to use. No mixing.

*For literature and free sample, call your bearing or industrial distributor or write us.*

**LOCTITE® SEALANT**

AMERICAN SEALANTS COMPANY
349 North Mountain Road, Hartford 11, Connecticut

..HIGH VOLTAGE TESTING
of CABLES, MOTORS, GENERATORS
and All Electrical Equipment

**Mobile D-C HYPOT®**

**Rugged . . Mobile . . for Production, Installation and Maintenance Testing**

*Output* . . 120 kv models provide up to 5000 microamperes d-c. 75 and 45 kv models offer up to 10 ma, d-c.

*115v A-C Line* . . Input through three-conductor power cord with standard two prong plug and grounding clip.

*Self-Contained, Fully Portable* . . Single mobile housing with rubber tired wheels and push handle contains metering circuitry and high voltage supply (oil immersed above 45 kv).

*Safe, Simple Operation* . . Direct reading of insulation leakage current. Fully interlocked, cabinet grounded, output cable shielded . . to protect operator and equipment.

. . for Every Application

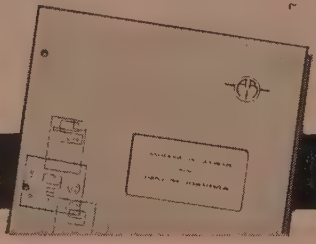
**Heavy Duty HYPOTS®**
A-C or D-C, to 150 kv.

**Bench Type HYPOTS®**
A-C to 35 kv, 2 kva
D-C to 45 kv, 25 ma

**Mobile HYPOTS®**
A-C to 30 kv, 10 kva
D-C to 120 kv, 10 ma

**Portable HYPOTS®**
A-C to 10 kv, 230 va
D-C to 5 kv, 2 ma

**Write for Manual J-67**
"Methods for Insulation Testing
. . Engineering . . Production
. . Maintenance



4—35.7

ASSOCIATED RESEARCH, *Incorporated*
3770 W. Belmont Ave., Chicago 18, Illinois

cuited turn. In the case of power applications it reduces the transmission of line transients or radio frequency noise from one circuit to another.—J.C.B.

ANSWER TO J41—A Faraday shield is used in conjunction with radio-frequency (rf) circuits. It is usually used where the rf is coupled between two circuits by means of air-wound transformers. The Faraday shield consists of a series of closely spaced parallel wires connected together on one end only and returned to ground. The shield is interposed between the two magnetic circuits to block or control capacitance coupling between windings. This helps to lower harmonic frequency transfer.

In power transformers electrostatic shields are used to reduce the coupling of noise impulses between the primary and secondary windings. The shields also help to reduce the build up of high internal static voltages.—J.L.C.

ANSWER TO J41—A Faraday shield allows a magnetic field to pass through without interference, but blocks an electrostatic field. When it is placed between the primary and secondary windings of a tuned radio-frequency (rf) transformer, it reduces the electrostatic capacitance coupling between the windings but does not affect the inductive coupling. This improves the interference-rejecting ability of the circuit.

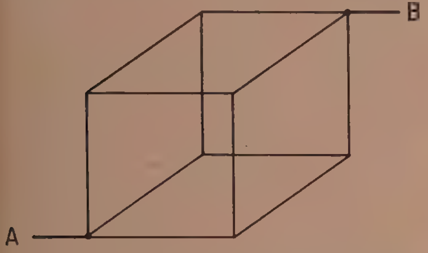
A Faraday shield is usually made by arranging a number of straight wires in a parallel and compact order on the flat surface of a square or rectangular mounting base. The base material can be paper or other thin insulation. Adjacent wires are insulated except for a common ground connection on one side of the base. Insulating varnish is used to attach the wires to the base.

On one side, a perpendicular wire is used as a common ground connection for the ends of the parallel wires. On the opposite side, the ends are left open. This arrangement prevents the formation of closed loops that would lower the Q of the shielded inductances.

One example of the use of a Faraday shield is in the design of a metal detector probe. If the probe, which contains the tank coil of an oscillator, is enclosed in a Faraday shield, the external capacitance effects produced by non-metallic objects will be eliminated, and the metal detector will respond only to metallic objects.—K.C.

## Can You Answer These QUESTIONS?

**QUESTION S41**—Note the accompanying drawing of a cube where each of the 12 line segments represents a 1-ohm resistor. What would



the resistance be across A and B, and what formula would be used to find the answer?—R.S.

**QUESTION T41**—We have a problem where our conduit runs to two air conditioners seem to get hot for no apparent reason. The building is served by 3-phase, 4-wire, 120/240 volts delta. The condensers are 3-phase, 230-volt, FL amps 28 on compressors, 2.8 on fans. We have three No. 8 TW wires in ¾-in. EMT to each unit with proper fittings made up tight. Length of runs are approximately 75 ft, with about 35 ft concealed above suspended ceiling and wood deck and joist construction. Clamp-on ammeter readings at both ends check out 30 amps (L1), 30 amps (L2), and 28 amps (L3). Voltage reads 238 volts. The wires in the disconnect switches at either end feel normal to the touch. I say the wire is large enough for the load and length of these feeders. Is this slightly higher voltage causing our trouble? Are we complying with Section 430-22 of the code?

We will replace the No. 8s with No. 6s in 1-in. conduit but would like your explanation on what we have overlooked.—J.N.

**QUESTION U41**—I am working on a project to be built in Germany. In the specification, the required lighting intensities are given in "Lux" and I would like to find out the equivalent footcandles. I searched for the conversion factor in many handbooks but cannot find it.

I would appreciate getting this information and finding out the basis of the unit "Lux."—J.A.

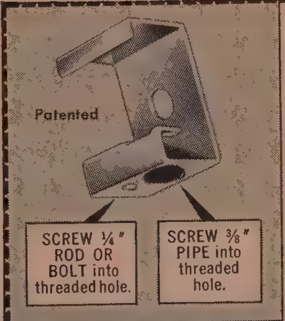
**PLEASE SEND IN YOUR ANSWERS BY SEPTEMBER 15**

Makes Fixture Hanging a Snap!

TOMIC
NO. 720 T-BAR HANGER

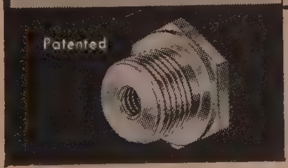
*for mounting electrical fixtures to exposed acoustical ceilings*

- Place Hanger on T-Bar and "Twist"
- No Tools Required—Locks Securely!
- Includes Washer and Wing Nut
- Fits Any Standard T-Bar Width
- Holds up to 400 lbs.
- Plated Spring Steel Construction
- Adjustable After Installation


Patented
SCREW ¼" ROD OR BOLT into threaded hole.
SCREW ⅜" PIPE into threaded hole.

**TOMIC 707 SNAP-ON FIXTURE CLIP** snaps onto lathing channels up to 1½" (or ½" pipe) for mounting flush, surface or stem fixtures from suspended ceilings. No tools required—three steps and the job is done!

SLIP
threaded end of clip over bottom of channel.
SNAP
clip over top of channel. This locks it in place.
SCREW
nipple or rod through clip until it butts channel.



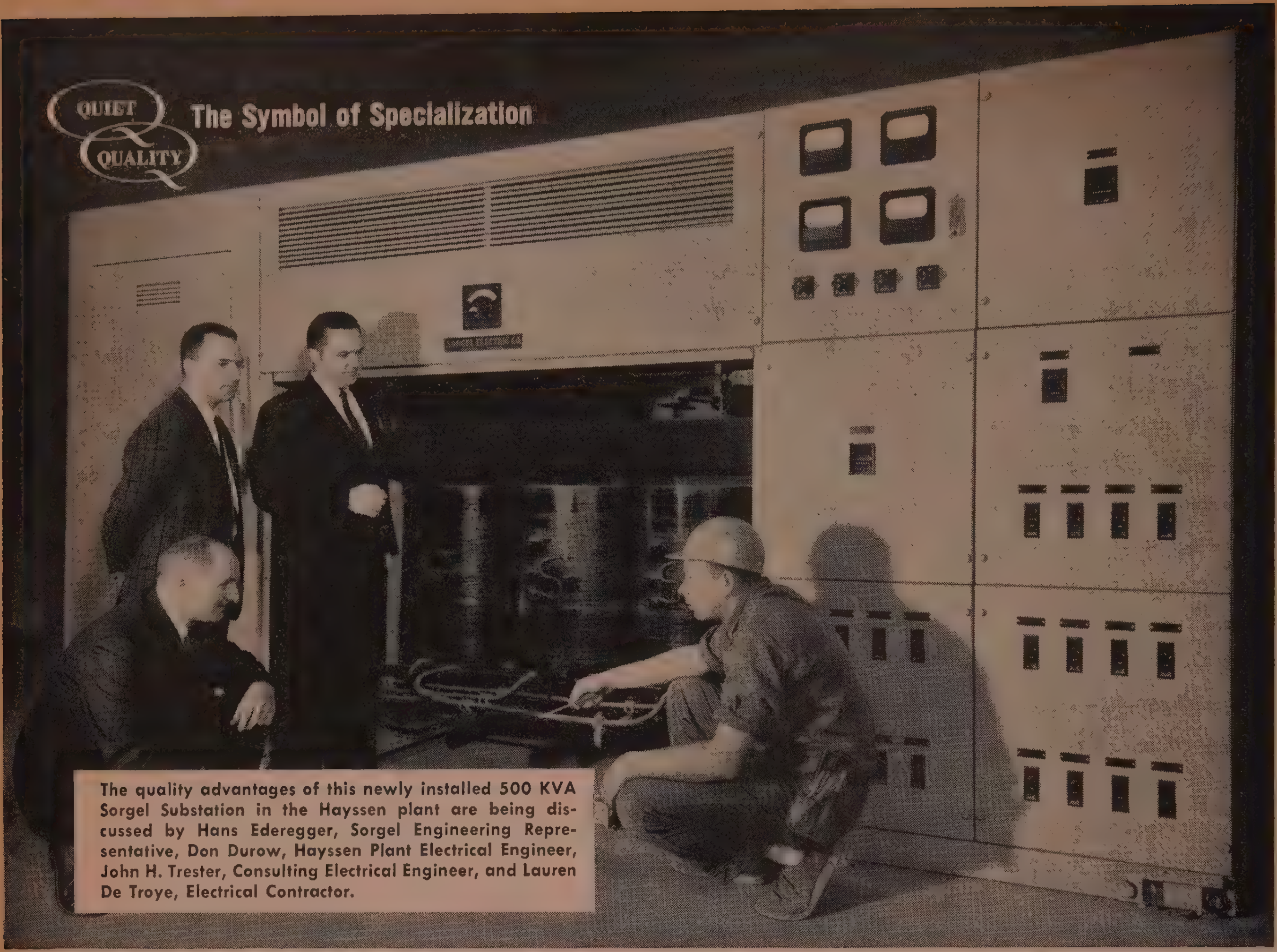
**TOMIC 711 ADAPTA-STUD** simplifies conversion from a ¼" or ⅜" rod or bolt to the fixture stem to complete installation.

*WRITE FOR CATALOG C-11 . . .*

FROM FIXTURE HANGERS TO RAINTIGHT EMT FITTINGS . . . TOMIC makes the *preferred* electrical line!

tomic
TOMIC SALES & ENGINEERING CO.
ELECTRICAL FITTINGS
20000 Sherwood Avenue, Detroit 34, Mich.

IN CANADA: Available through Amalgamated Electric Corp., Ltd. Branches


QUIET QUALITY The Symbol of Specialization

The quality advantages of this newly installed 500 KVA Sorgel Substation in the Hayssen plant are being discussed by Hans Ederegger, Sorgel Engineering Representative, Don Durow, Hayssen Plant Electrical Engineer, John H. Trester, Consulting Electrical Engineer, and Lauren De Troye, Electrical Contractor.

# ANOTHER EXPERIENCED ELECTRICAL TEAM SPECIFIES AND BUYS SORGEL

In Hayssen Manufacturing Company's new, modern Sheboygan, Wis., plant, the electrical distribution system is of prime importance. In planning, the *plant engineer* insisted on quality dry-type transformers at the heart of the electrical distribution system, as he wanted the utmost in dependability to assure a continuous power supply for all production machinery, lighting, and electrically operated tools. The *consulting engineer* wanted a distribution system that would assure continuity of operation and maximum efficiency at all load conditions. The *electrical contractor* was interested in the kind of economy provided through equipment that was easy to install and guaranteed to perform as rated. After careful comparisons, this team specified Sorgel above all others.

These quality-conscious men liked Sorgel's guaranteed performance data policy and national reputation for designing and providing the finest substations and dry-type transformers. The results are exactly the type of dependable, highly efficient electrical distribution system Hayssen (one of the world's leading manufacturers of intricate automatic packaging machinery) insisted on.

**WRITE FOR LATEST SORGEL LITERATURE TODAY.**

**SORGEL SOUND-RATED DRY-TYPE TRANSFORMERS**

*Complete Line for Every Purpose up to 10,000 Kva, up to 15,000 Volts, Including Special Transformers and Saturable Reactors*

**SORGEL ELECTRIC COMPANY**

**836 West National Ave., Milwaukee 4, Wisconsin**

**Sales engineers in principal cities.** *Consult the classified section of your telephone directory or communicate with our factory.*

# Code Forum

*Answered by:*

**J. C. HEWITT,** *Chief Electrical Inspector, Department of Labor and Industries, State of Washington, Olympia, Wash.*
**R. L. LLOYD,** *Electrical Safety Engineer, National Bureau of Standards, Washington, D. C.*
**B. Z. SEGALL,** *Consulting Electrical Engineer, New Orleans, La.*
**R. E. WARD,** *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

**READERS are invited to submit questions regarding the National Electrical Code and its practical application to this Department. Questions are answered by the consulting editor whose initials appear at the end of each item. The views and opinions expressed are, in each instance, those of the individual consultant replying and are not necessarily those of his employers, of this publication or of a Code-making committee or panel on which he may serve in an official capacity.**

## Well Casing as Grounding Electrode

**Q.** *Is it the intent of Section 250-81 of the code that a metallic well casing more than 10 ft long connected to a non-metallic (plastic) piping system be considered as a grounding electrode without other grounding electrodes? — A.G.T.*

**A.** For our readers' convenience, Section 250-81 is quoted as follows:

"Water Pipe. A metallic underground water piping system, either local or supplying a community, shall always be used as the grounding electrode where such a piping system is available. Where the buried portion of the metallic piping system is less than 10 ft (including well casings bonded to the piping system) or there is some likelihood of the piping system being disconnected, it shall be supplemented by one or more of the grounding electrodes recognized in Section 250-82 and 250-83."

You will note the only mention of well casings is in the parenthetical clause, and this states "bonded to the piping system." The emphasis in the entire section is on a *metallic* underground water piping system. Therefore, in my opinion it is not the intent of the code that the well casing alone could constitute the grounding electrode. There is certainly a likelihood that the grounding connection would be disconnected from the pump housing or well casing where it is necessary that the well casing be pulled for repairing or replacement.

The metallic well casing could certainly be used as a supplementary ground. However, in many instances local conditions would govern whether or not such would be practical. Several factors are: the distance from the electric service to the pump location; grounding practices of the supplying utility; lightning protection; type of pump to be used—above ground or submersible. In fact, the electrical contractor should make tests to determine whether or not effective grounding has been accomplished regardless of the number or material of the electrodes used.—R.E.W.

## Air Conditioning and Electric Heating

**Q.** *A single 20-amp 240-volt single-phase circuit supplies a 14-amp air conditioning unit and 3.8 kw of electric strip heaters in a single room. Is it the intent of the code to utilize a single branch circuit in this manner?—H.M.*

**A.** It is simply a matter of common sense as to the code application for this problem.

Electric strip heaters are used in many ways and combinations with air conditioning units. If each is to perform a separate function at a separate time and not simultaneously, then one circuit may be sufficient. A 3.8 kw load at 240 volts will require about 16 amps. The protective device for the air conditioning would be sufficient for this load. Some inspectors may require some definite means to assure that both units could not operate simultaneously, for example a double-throw switch, relay, interlocking contacts, etc.

In the case of some heat pumps, the air conditioning unit and the heater strips are required to operate simultaneously. In this case the single circuit would be a more practical installation. However, there is the problem of giving proper protection to each individual unit as well. Some packaged units have such a combination and have UL listing for installation on a single circuit.

It is, therefore, the intent of the code to properly protect each individual appliance without interfering with the approved and proper and normal operation of these individual appliances. This may require a single circuit, or it may require several circuits. It all depends on what is required by the system.—B.Z.S.

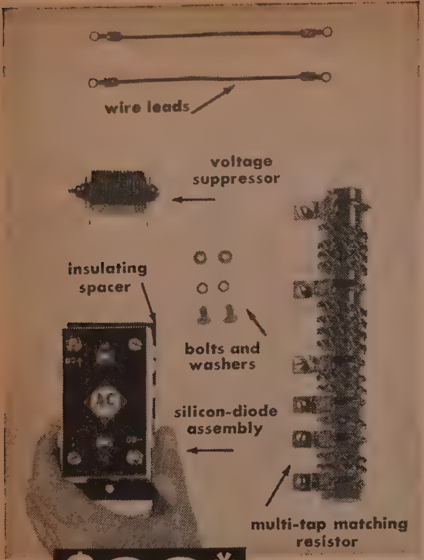
## Number of Conductors in Wireways and Gutters

**Q.** *Previous to the 1959 edition of the National Electrical Code, the number of conductors allowed in conduit, wireways and auxiliary gutters was limited. The 1959 code more or less removed the number of conductors that may be installed in a raceway or cable when the current-carrying capacity of the conductors is reduced as given in Note 8 of Section 310-11. Section 362-5 of the 1959 code limits the number of conductors in a wireway to 30 with certain exceptions. Section 374-5 limits the number of conductors in auxiliary gutters the same as Section 362-5 for wireways.*

*By reducing the current-carrying capacity of conductors in wireways or auxiliary gutters, will the code permit more than 30 conductors?—J.B.S.*

**A.** No, unless such conductors are used for the purpose of signaling circuits or control conductors between a motor and its starter and used only for starting duty. You will note the last line in both Sections 362-5 and 374-5 states: "The correction factors specified in Note 8 of Tables 310-12 and 310-14 are not applicable to the foregoing."

The proposed amendments to the 1959 edition of the NEC contained a proposal that would have changed the number of conductors allowable in wireways. The proposal was in the form of a table that would



$99*

silicon-diode rectifier kit eliminates aging resistor in alternating-current operated breakers

This Allis-Chalmers modernization kit *improves* breaker reliability to close at *rated* speed. The kit converts alternating-current operated breakers equipped with copper-oxide rectifiers to silicon-diode rectifiers — where the closing current (E/R value) is 100 amps or less.

The silicon-diode rectifier eliminates need for an aging resistor and its usual periodic adjustment. The silicon unit requires no adjustment or maintenance when properly applied and installed.

The kit also supplies a heavy duty matching resistor to compensate for the resistance of the copper-oxide rectifier removed from the circuit.

One man, in less than 30 minutes, completes the conversion with a screw driver, pliers and a small drill.

*Conversion Kit Contains*: silicon-diode assembly with insulating spacer, voltage suppressor, two 6″ leads, multi-tap matching resistor, mounting nuts, bolts and washers.

*Kit Prices: $99.00 each in quantities of 25 or more; $110.00 each in quantities up to 24 units.

*For detailed information, contact your nearest A-C representative or write to* **Allis-Chalmers,** *Milwaukee 1, Wisconsin.* A-1646

have more or less allowed an unlimited number of conductors in a wireway if such wireway was large enough. This proposal was unanimously rejected with the code panel comment as follows:

"The present provisions were retained in the code after careful consideration at the time of the 1959 revision following review of the general fact-finding report on heating and fill of raceway. No substantiating reason has been submitted to consider a revision."—R.E.W.

## Fuse Reducers

**Q.** *Paragraph 240-23(b). Is it permissible to install a fuse reducer for cartridge fuses in a pull-out type fuseholder, such as in conventional service equipment, to permit 30-amp fuses in a 60-amp fuse gap with permanently attaching the reducer by solder or otherwise?—F.M.*

**A.** This section does not require the fuse reducer to be permanently attached. If approved fuse reducers have been permitted for any specific installation, it is only required that they be installed in accordance with the approved method submitted by the manufacturer. In general, this does not require solder or other such permanent attaching method.—B.Z.S.

## Overcurrent Protection for Panelboards

**Q.** *We have a school building that requires service equipment of 800-amp capacity. Adjacent to the 800-amp main service switch there will be two panels—one panel being rated at 800 amps that will be used as the main distribution panel for motors and panel feeders; the other panel will be a 200-amp panel with overcurrent protection for several small motors and spares for future additions. Does the code require the 200-amp panel to have overcurrent protection other than the 800-amp main switch?—W.C.*

**A.** Your question is answered in Sections 384-14 and 384-16. Section 384-14 defines a lighting and appliance branch-circuit panelboard, and states that it is one having more than 10% of its overcurrent devices rated 30 amps or less, for which neutral connections are provided. Section 384-16 states in part that a lighting and appliance branch-circuit panelboard supplied by conductors having overcurrent protection greater than 200 amps shall be protected on the supply side by overcurrent devices having a rating not greater than that of the panelboard.

Therefore, if the 200-amp panelboard is a lighting and appliance branch-circuit panelboard, as defined by Section 384-14, such panelboard will require the overcurrent protection as specified in Section 384-16.—R.E.W.

## Installation of UF Cable

**Q.** *When using single-conductor underground feeder cable buried directly in the earth, will the code allow such conductors of the same circuit to be buried in separate trenches?*

*Will the code allow the conductors to be in the same trench with water piping or other conductors such as is used for communication circuits?—A.B.H.*

**A.** In answer to your first question Paragraph 339-3(b), which pertains to underground feeder and branch-circuit cable, states: "Where single-conductor cables are installed, all cables of the feeder circuit, sub-feeder circuit, or branch circuit, including the neutral conductor, if any, shall be run together in the same trench or raceway." Therefore, the code would prohibit an installation as outlined in your first question.

In answer to your second question, the code does not either approve or disapprove the installation of underground feeders in the same trench with water piping. Certain clearances are required under certain conditions for communication circuits from light or power conductors. Voltage would enter into the distance required in most installations, as well as other conditions concerning the installation. Due to the fact that there is a likelihood of maintenance work having to be done on any piping system or any installation, I certainly would not recommend the placing of underground feeder cable with other material such as you mention unless supplementary protection was provided for the underground feeder, separating it from water piping, etc., and my requirements would be based on Paragraph 339-

COM·PAK
Scotch
BRAND
Vinyl Plastic Electrical Tape
No.
33
3M
THE
STANDARD OF VALUE
IN ELECTRICAL TAPE
NOW SETS A
NEW STANDARD
IN PACKAGING

# COM·PAK

## new COM-PAK QUANTITIES

**TEN ROLLS TO A CARTON, TEN CARTONS TO A CASE.**

Com-Pak quantities of ten make ordering easier, figuring faster. Make keeping track of amounts and accounts simpler. It's easier to earn maximum discounts, too.

**Buy the convenient, economical, 100-roll case.**

## new COM-PAK ASSORTMENTS

Job-rated rolls, most wanted and most used by electricians. 20-foot, 66-foot and new 44-foot lengths. Pick the roll size to fit the job. You always have enough tape—not too much or too little. Helps prevent wasted time, wasted tape.

**Makes economical case buying easier.**

**NOBODY CAN GIVE YOU TAPE SATISFACTION LIKE Scotch® BRAND**

"SCOTCH" AND THE PLAID DESIGN ARE REGISTERED TRADEMARKS OF 3M CO., ST. PAUL 19, MINN.

# PACKAGES • ASSORTMENTS • PRICES . . . new tape buying convenience from 3M COMPANY !

## new COM-PAK SINGLE ROLL PACKS

Easy to identify, carry and use. Familiar plaid design says immediately, "You're using the best." Tape is always clean and fresh, ready for use. **Each roll "protectively packed" within a 100-roll case.**

## new COM-PAK DISPENSERS

Handy Taping Dispenser FREE! New Com-Pak dispenser comes complete, ready to use, at no extra charge on ¾" x 44-foot and ¾" x 66-foot rolls of No. 33. Dispenses, cuts; makes taping easier. **Get a case, specify No. 33D.**

## new LOW PRICES

3M now brings you highest quality "Scotch" Brand Vinyl Plastic Electrical Tapes at new low prices. Every roll costs you less. Makes it a better buy than ever before.

**Buy the 100-roll case for full value savings.**

## same HIGH QUALITY

No matter how you buy it . . . can, box or dispenser, you're assured of uniform, consistent high quality, roll after roll after roll. You get a proper balance of necessary electrical properties in every roll of "Scotch" Brand Vinyl Plastic Electrical Tape. Result! Tape you can depend on. Tape that handles easily in every situation. Tape that saves time, saves money. **Get a whole case of quality.**

**available from your distributor**

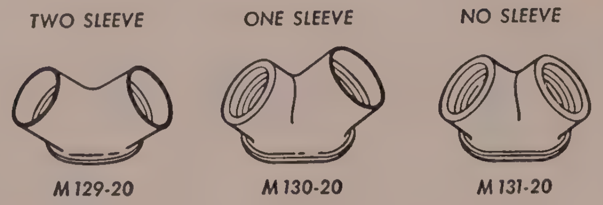
3M MINNESOTA MINING & MANUFACTURING CO.
2501 HUDSON ROAD, ST. PAUL 19, MINN.

# TIME SAVERS FOR YOUR UNITS MANUAL

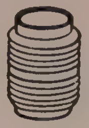
No. 3

## • Quick Turn of the Corner—PULL CORNER ELBOWS

**BASIC FITTINGS**

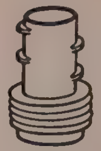


PLUS



Male Nipple

AND



Flexible Conduit Adapter

- *Low-cost versatility*
- *Wide range application*

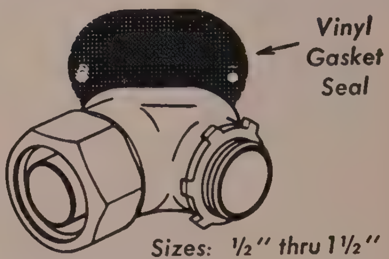
Changes for rigid conduit male and system change from flexible steel conduit to rigid—use nipple or adapter.

---

## • PULL CORNER ELBOW—LIQUID TIGHT

*Remember this fitting—it will get wiring in and out of tight places in liquid-tight conduit systems. Same rugged value as couplings and connectors.*

*Write for Conduit Fittings Catalog*

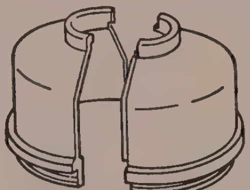


Sizes: ½″ thru 1½″

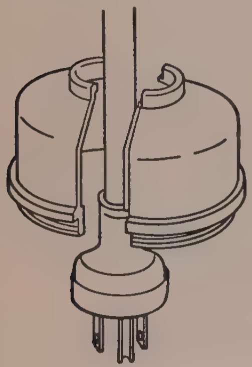
## • SPLIT BELL NOZZLE

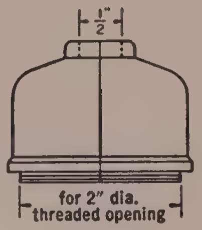
*Saves wiring time. The keyed, two-part fitting locks together when screwed into cover plate. Eliminates the need for cutting off and then replacing the molded attachment plug. Screws into Std. 2″ Threaded Cover Plate opening.*

Die-cast aluminum. Available in bronze or satin aluminum epoxy resin finish.



Cat No. 700

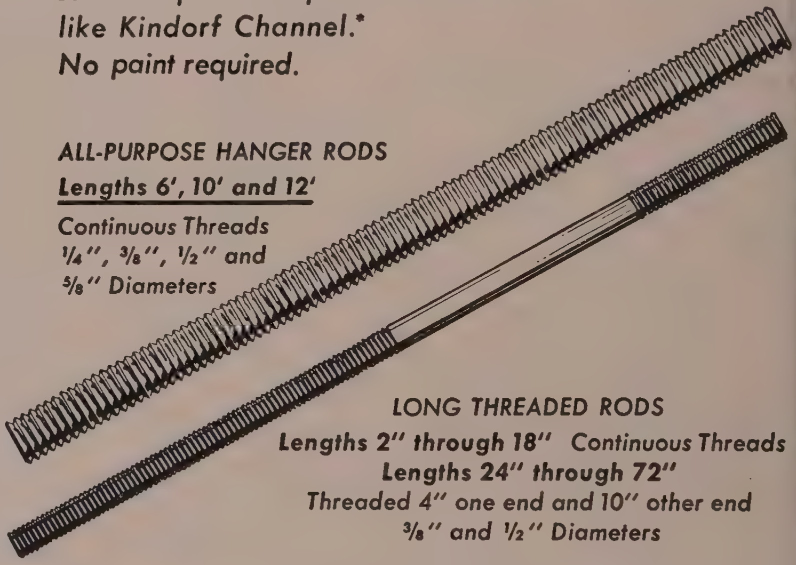




*Write for Bulletin SN*

## • HANGER RODS

*Good quality hanger rod with full galvanized protection against rust is an investment in fast installation and low maintenance. Free-running threads saves tempers. Rust-proofed like Kindorf Channel.* No paint required.*



ALL-PURPOSE HANGER RODS
**Lengths 6′, 10′ and 12′**
Continuous Threads
¼″, ⅜″, ½″ and ⅝″ Diameters

LONG THREADED RODS
**Lengths 2″ through 18″ Continuous Threads**
**Lengths 24″ through 72″**
Threaded 4″ one end and 10″ other end
⅜″ and ½″ Diameters

*Galv-Krom finish—an electrogalvanized finish PLUS added protection of zinc chromate.

*Write for Hangers and Supports Catalog*

STEEL CITY BRINGS YOU
*Better Values in Electrical Fittings*

**Steel City**
PITTSBURGH 33, PA.

STEEL CITY ELECTRIC CO.— A CONSTRUCTION MATERIALS DIVISION OF **MARTIN MARIETTA**

3(c) which states: "Where buried directly in the earth, supplementary mechanical protection, such as a covering board, concrete pad, raceway, etc. when considered necessary, **may** be required by the authority enforcing the code." — R.E.W.

## Series Lighting System

**Q.** *Does the code permit the installation of an ungrounded 480-volt series lighting system which is to be run overhead on a college campus? What code sections are applicable? What about the same question with the voltage exceeding 600 volts?—M.S.*

**A.** Yes. There is nothing in Article 730 that specifically prohibits such a system.

All the sections of Article 730 of course apply and particularly the additional articles as outlined in Section 730-2.

As indicated in Section 730-2, Article 710 shall be applied for the additional requirements for circuits, etc., operating at more than 600 volts.—B.Z.S.

## Receptacles for Cooking Appliances

**Q.** *In a large tract development we plan to provide a 50-amp No. 6 branch circuit for one wall-mounted oven (4 kw) and one counter-mounted cooking unit (6 kw) in each residence. The builder wants us to install receptacles at each oven and cooking unit. What size receptacles would be required at each appliance?—B.H.*

**A.** While Paragraph 210-24 (c) permits a 50-amp branch circuit to serve two or more fixed cooking appliances, Paragraph 210-21 (b) requires that receptacles installed on 50-amp circuits of two or more outlets shall be rated at 50 amps. As a result, the receptacles for your 4-kw ovens and 6-kw cook tops must be of the 50-amp rating. In addition, the leads to each unit must be sized according to the appliance nameplate rating with minimum tap and cord sizes as given in Table 210-25 and Exception No. 3 of Section 240-5. And in case 3-pole receptacles are used to provide the grounding of the units to the neutral, as permitted in Section 250-60, the size of the neutral conductor cannot be less than No. 10. And finally the plug and receptacle combinations are not considered as the disconnecting means for the appliances in question and must be approved for the temperature of the space in which they are installed (see paragraph (b) of Section 422-13).

Unless there is a special need for the receptacles, it would seem to be more practical and economical to wire the units direct, using a single 50-amp branch circuit or two smaller branch circuits.—J.C.H.

## Dining Area

**Q.** *In some dwelling occupancies the blue prints do not show a dining area and call the area next to the kitchen a family room. The kitchen is too small to have a table for eating and, therefore, have only two outlets on one 20-amp circuit. Does this satisfy Paragraph 220-3(b)?—G.B.T.*

**A.** No. The eating habits of America have been revolutionized. What with outdoor barbecues, television dining, midnight snacks, etc., we may say that the entire dwelling occupancy is a dining area.

These family areas are definitely eating areas. Much entertainment is done in this area and their use has built up the electrical utilization of dining-type appliances such as coffee makers, toasters, hot plates, broilers, fryers, etc. In my opinion the entire family room, or den, or recreation room or rumpus room, or whatever you may want to call it, is a giant kitchen dining area and should be so treated.

It is interesting to note that the proposed 1962 Code is doing something about this single branch circuit in the kitchen. A new proposed requirement in Paragraph 220-3(b) states:

"Receptacle outlets supplied by at least two appliance receptacle branch circuits shall be installed in the kitchen."—B.Z.S.

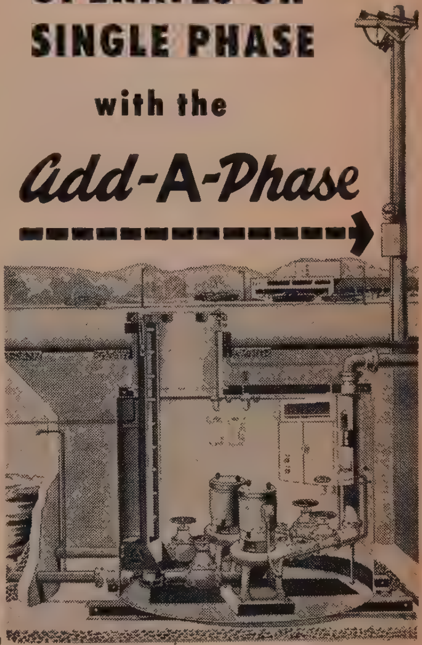
## Electric Heaters On 30-Amp Circuits

**Q.** *Is it permissible to connect electric baseboard heaters on 30-amp branch circuits in residential occupancies? The heaters are*

★ "MARKETS UNLIMITED" ★

THREE PHASE SEWAGE PUMPING STATION...... OPERATES ON SINGLE PHASE

with the

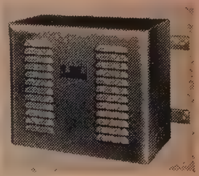


SMITH & LOVELESS
Division — Union Tank Car Company
LENEXA, KANSAS

Artist's installation drawing of a Smith & Loveless factory-built duplex sewage pumping station. The Smith & Loveless pump station is designed for capacities from 100 GPM to 4,500 GPM per pump with two or more pumps per station.

Add-A-Phase POWER CONVERTER

- Balances for Any Load
- 100% Rated Load
- High Power Factor
- Balanced Currents
- No Loss of Work Power



*Write for Complete Information*

ADD-A-PHASE Dept. ECM-8
Div. System Analyzer Corp., Nokomis, Illinois
Gentlemen: Please send, without obligation, complete details on your ADD-A-PHASE Power Converter.
Name________Title________
Company________
Address________
City________Zone________
State________

SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.

BLACK & DECKER

TOOLS FIXED

- √ FULL GUARANTEE on all recommended repairs
- √ NEW PRICE POLICY saves you money
- √ FAST REPAIRS in 24 hours or less
- √ GENUINE FACTORY PARTS made for your B&D tools
- √ ALL REPAIRS MADE by tool experts
- √ FREE REPAIR ESTIMATE on request

OVER 100 REPAIR CENTERS. Check the Yellow Pages under "Tools Electric" or write for address of nearest service station. TOOLS ELECTRIC

Black & Decker
Towson 4, Md.
QUALITY TOOL SERVICE

*rated from* 1.5 *to* 4 *kw, and we propose to group them on* 230-*volt,* 2-*wire* 30-*amp circuits so that the total load on each circuit will not exceed* 5500 *watts. The heaters are permanently connected.—A.J.B.*

*A.* Paragraph 210-24 (b) of the 1959 NEC states, in part, that appliances in any occupancy may be connected to 30-amp branch circuits having two or more outlets. And to pursue this a bit further, the definition of an "appliance" in Article 100 includes heating equipment in the examples cited.

Since you state the total heater load on each 30-amp circuit will not exceed 5500 watts, this means that each branch circuit will not exceed 24 amps (5500/230). In effect, the maximum loading would not exceed 80% on any 30-amp circuit, which signifies good design practice. By derating the load on each circuit, this will take care of possible increases in current due to voltage surges in the utility supply.

Table 210-25 summarizes branch-circuit requirements for sizes of circuit wires, taps, overcurrent devices, etc. in connection with 30-amp circuits.—J.C.H.

## Grounding Fixed Equipment

*Q. Under Section* 250-42, *Grounding of Fixed Equipment, it is stated: "Under any of the following conditions, exposed, non-current-carrying metal parts of fixed equipment, which are liable to become energized, shall be grounded . . ."*

*Can metal housings of fixed equipment, which are exposed, containing conductors approved for the purpose with connections made according to code requirements be classed as non-current-carrying metal parts that are not liable to become energized? In other words, can insulation of conductors and splices be accepted as guaranteeing housings not to become energized?—B.W.*

*A.* No, such equipment would require grounding if required by Article 250 of the code. Generally speaking, decorative metal parts, where grounding is impractical and where such metal parts are so located with respect to live parts that it is a very remote possibility they would ever become energized, would be an example of metal classed as not liable to become energized.

Your question calls to mind thre investigations of deaths by electrocution that I have made. Two wer caused by outlet box screws penetrating taped connections where non-metallic system of wiring ha been used with metal boxes. Th other was apparently caused by surge of lightning rupturing taped connection of a circuit conductor in an electric range weldin the conductor to the frame of th range. The frame of the range wa not grounded, and from the physical evidence of the connection th condition had existed for probabl several years. On one of the junction box accidents such could hav existed for ten years as the installation was ten years old. Needles to say, grounding of the boxes ha not been done in either case.—R.E.W.

## Type SE Cable

*Q. Is it permissible to use Type SE Cable with the "covered' neutral to feed a sub-panel withi the same building?—J.D.G.*

*A.* No. The 1962 proposed revisions are attempting to clarify this matter. The following abstract from proposed Paragraph 338-3(b) indicates a more definite language than does the present code wording:

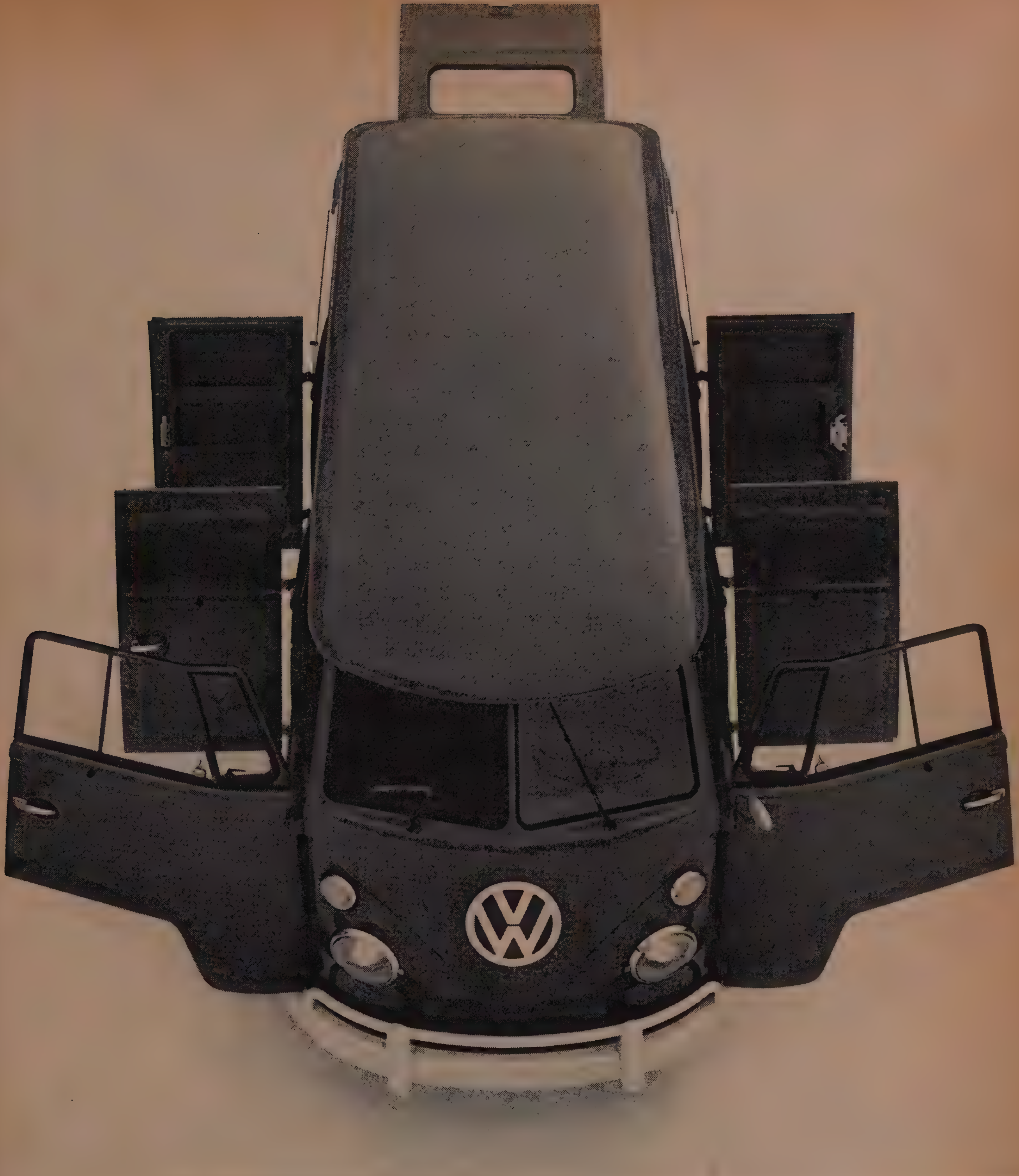
"Service-entrance cables without individual insulation on the grounded circuit conductor SHALL NOT BE USED AS A BRANCH CIRCUIT OR AS A FEEDER WITHIN A BUILDING except a cable which has a fina non-metallic outer covering and when supplied by alternating current not exceeding 150 volts to ground, may be used . . . or (2) AS A FEEDER TO SUPPLY ONLY OTHER BUILDINGS ON THE SAME PREMISES IT SHALL NOT BE USED AS A FEEDER TERMINATING WITHIN THE SAME BUILDING IN WHICH IT ORIGINATES."

Note: The capitalizations are by the writer and indicate the new proposed 1962 wording.

It is of interest to point out, furthermore, that the supporting comments of the panel has this statement:

"Also, where used as a feeder to supply another building on the premises the cable should terminate on the exterior of such building."

This recommendation is not included in the proposed 1962 revisions but it is of interest since it brings out the further intent of this requirement.—B.Z.S.



©1962 VOLKSWAGEN OF AMERICA, INC. *SUGGESTED RETAIL PRICE. †SUGGESTED PRICE, EAST COAST P.O.E. PLUS TRANSPORT, LOCAL COSTS, TAXES

# 1 door, 2 doors, 3 doors, 4 doors, 5 doors, 6

No blind spots.

You don't have to wait until the guy behind you leaves to open a door.

You don't have to stand in the slush in the gutter to load.

Or climb inside, either.

Or take everything out to get at something in front.

Or lift heavy stuff a couple of feet up from the street.

The Volkswagen's side doorways are only a few inches up from the sidewalk.

And they're almost 4 feet wide. Cockeyed sizes and shapes are easy to get in.

You can reach almost everything from the sidewalk.

Either sidewalk.

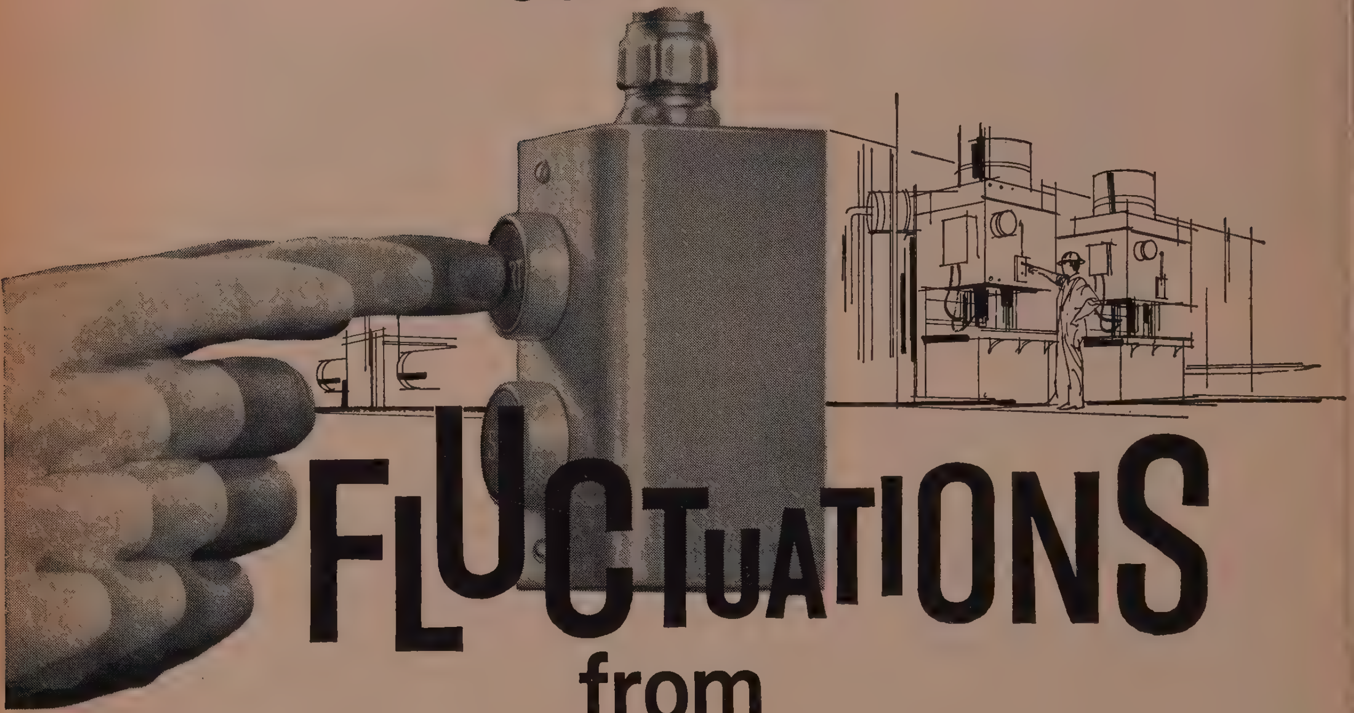
There's just one thing. The double doors on the driver's side are extra. $80.*

But the rest of the truck sells for only $1895.†

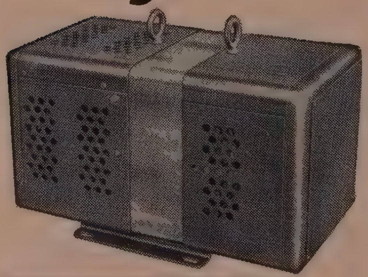
You could buy the extra doorway first.

And add the truck later.

# SOLAtron LINE VOLTAGE REGULATOR corrects



# FLUCTUATIONS from the very first cycle



**Responds up to 10 times faster than electromechanical devices** . . . irons out fluctuations due to both line and load changes! Voltage correction is practically *concurrent* with every disturbance; starts long before output voltage nears the boundaries of the regulation envelope. Even under extreme conditions, correction never takes more than one-sixth second. And *talk about reliability!* Solatron line voltage regulators eliminate moving parts; rule out mechanical wear and tear. Complete maintenance-free operation. Solid-state sensor monitors actual output . . . then regulates the transformer *flux* to automatically maintain correct nominal voltage.

SOLA

S-7-63

B P
C

Division of Basic
Products Corporation

SOLA ELECTRIC CO., 1717 Busse Road,
Elk Grove Village, Illinois, HEmpstead 9-2800

IN CANADA, SOLA BASIC PRODUCTS, LTD.,
377 Evans Avenue, Toronto 18, Ontario

**Compare the advantages:**

**Superior performance** — regulation ±1% for line and load variations, zero to full load.

**High efficiency** — 95% or better at full load.

**"Lifeguard circuitry"** — withstands momentary overloads many times rated current.

**Input PF** — 90% minimum on unity PF loads.

**Smaller, lighter**—considerably more compact than other standard regulators.

Solatron line voltage regulators are offered in ratings from 3 to 100 kva, for 120 and 240 vac, 60 and 400 cycles. For more information contact your local Sola distributor or call us direct.

***See us at the 1962 WESCON Show—Booths 2063, 2064 and 2065 (Concourse Level)***

## John C. Hewitt New Consulting Code Editor

John C. Hewitt, chief electrical inspector of the State of Washington, joins our panel of consulting editors this month. He will contribute to the "Code Forum" department of *Electrical Construction and Maintenance.*

Mr. Hewitt is an acknowledged authority on the National Electrical Code and electrical inspection procedures. His background of 25 years in the electrical industry includes experience as a wireman, estimator, electrical contractor, and chief maintenance electrician. In 1949 he accepted the position of chief electrical inspector for the State of Washington. Previously, he had been an electrical inspector for the City of Seattle, and had also served as a member of the Seattle Electrical Code Review Board.

The State of Washington requires all electrical contractors within the state to be licensed and bonded, and the State Code is based on the latest edition of the NEC. Much of Mr. Hewitt's activities concerns code interpretations and inspection policies in the State of Washington.

## LaFehr Named IAEI Managing Director

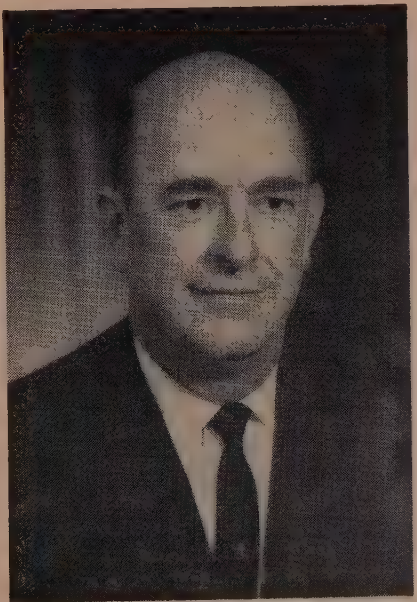
L. E. LaFehr, chief electrical inspector, Alhambra, Calif., has been appointed by the IAEI Executive Council to the newly created post of Managing Director of the International Association of Electrical Inspectors. He is scheduled to assume his new duties August 1 at the Association's Chicago headquarters.

A native Californian, Mr. LaFehr has spent most of his career in the electrical field. Born in Los Angeles, he attended public schools in several southern California cities; was graduated from Fremont High School; attended the University of Southern California.

He began his electrical career in 1926 as an apprentice electrician. Subsequently he gained experience as an electrician, electrical estimator and superintendent. Among his employers were the County of Los Angeles and several southern California electrical contractors.

During World War II, Mr. LaFehr was a Chief Electrician's Mate in the United States Naval Reserve. He served in the Sea Bees and was assigned to Ship Repair Service. While in the Navy, he taught basic electricity at the Algiers Naval Station in New Orleans. From 1957 through 1959, he lectured on the National Electrical Code at Pasadena City College.

In 1947, Mr. LaFehr joined the City of Alhambra Building Department, Electrical Division, as an electrical inspector and became an active member of the IAEI. Through his active interest in IAEI affairs, he gained prominence in local, sectional and international IAEI levels. He is a past-chairman of the Southern California Chapter; a past-president (1953) of the Southwestern Section; and since 1954 has been secretary-treasurer of the Southwestern Section, IAEI.



**L. E. LaFEHR** has been appointed managing director of IAEI

Since 1960, Mr. LaFehr has served the IAEI as a member of Code Making Panel 11 where he is chairman of a technical sub-committee studying multi-speed and part-winding motors for the purpose of establishing future code rules.

In 1961, the board of directors of the National Fire Protection Association appointed Mr. LaFehr to the National Electrical Code Correlating Committee.

## IES Evaluates Lighting For Leisure

The Illuminating Engineering Society held its 1962 Northeastern Regional Conference June 10-12 in the Hotel Thayer, on the grounds of the United States Military Academy at West Point, N. Y. Devoting its technical sessions primarily to "Lighting for Leisure," as a conference theme, it attracted an attenddance of over 200 members and guests, from New York State, New Jersey, and New England. As usual, the conference program included both technical sessions and a round of social functions, which kept those registered for the two-day meeting fully occupied throughout their short visit.

A highlight of the conference was an address by the Society's national president, James R. Chambers, sales manager, Appleton Electric Co., Chicago. In his address, Mr. Chambers praised the country for its educational system, both public and private, but pointed out that the most critical problem in the schools is the lack of adequate classroom lighting. "With new schools by the score going up throughout the country, nearly 75% of all usable classrooms have substandard seeing conditions," Mr. Chambers said.

The IES, in collaboration with the American Institute of Architects and the National Council for Schoolhouse Construction has recently completed a new *School Lighting Guide,* Mr. Chambers reported, designed to help school boards and school administrators provide illumination that will help pupils to see efficiently and comfortably.

New Installation Economy
For Difficult Mounting Jobs!
Save Time and end guesswork with
"SIZE-MARKED"®
MINERALLAC
★ Scissor Clips
★ Two-Piece Stud Clips
★ Min-A-Clips

Minerallac is the originator of the most complete nd most imitated line of clips on the market today. Minerallac Clips are the answer to the problem of anging fixtures, etc. on T-Bar Grid Ceilings—Bulb-T-Iron or Beams—and installing conduit, pipe, boxes nd fixtures on "Poured Deck Type Roofs."

MINERALLAC SCISSOR CLIPS
For hanging fixtures, etc. on T-Bar Grid Ceilngs. A two-piece clip for mounting fixtures, oxes or conduit hangers to a 1-inch T-Bar. Easy to install. Locks in place. Test loads over 100 lbs. Zinc plated steel.

MINERALLAC TWO-PIECE STUD CLIPS
For mounting boxes, hangers or fixtures to Bulb Tee Irons or Beams heavier than the 1-nch T-Bar. This clip will fit flanges 1⅝" to 2⅝" width and up to 5/16" thick. Test load over 100 lbs. Zinc plated steel.

MINERALLAC MIN-A-CLIPS
The most efficient and economical method for installing conduit or pipe on Bulb Tee Irons of "Poured Gypsum Deck Type Roofs". Hanger turns on rivet, eliminating many bends. Safe load 30 lbs. Zinc plated steel.

**Exclusive Feature!**
Each Minerallac fitting is "SIZE-MARKED". All are clearly and individually stamped with its exact size for immediate identification and quick and easy handling. Ends time-consuming guesswork and costly mismatches in the stock room and on the job.

WHEN IT'S "SIZE-MARKED" YOU CAN BE SURE!

Order from Your Electrical Wholesaler
LITERATURE OR SAMPLE ON REQUEST

MINERALLAC Electric COMPANY
ESTABLISHED 1894
25 N. PEORIA STREET • CHICAGO 7, ILLINOIS

**IES PRESIDENT** James R. Chambers tells delegates to the 1962 IES Northeastern Regional Conference, held at West Point, N. Y., that 75% of America's school classrooms are inadequately lighted. He also reported that IES in cooperation with AIA and National Council for Schoolhouse Construction, has recently issued a new School Lighting Guide which will help in solving this problem. Also at table are (l to r): Robert L Zahour, IES Regional Vice President, and Gene G. Rae, Holophane Co., Inc., Conference General Chairman.

Mr. Chambers, who was honored at the President's Luncheon, at which he delivered this key address, was also honored by a reception, dinner, dance and entertainment on the evening of the same day.

The conference's program activities consisted of three technical sessions, each devoted to a special phase of "Lighting for Leisure," and an Applied Lighting Competition in which ten contestants each presented the solution of a lighting problem. The solution was in the form of a lighting installation which had been completed within the past 18 months.

### *Technical Sessions*

The first technical session was devoted to lighting for sports and entertainment. The presiding chairman was Marshall N. Waterman, Westinghouse Electric Corp., and a past-president of the Society. Four speakers each covered a separate topic in this field of lighting.

R. L. Henderson, General Electric Co., discussed the lighting needs of marinas and water sports, suggested appropriate lighting techniques, and demonstrated some new lighting units which are applicable to the lighting problems involved.

Donald Brown, Crouse-Hinds Co., discussed lighting for golf, baseball, skiing, and similar outdoor sports. A new trend is that of lighting the last three holes of a golf course, he said, which extends playing time about one hour. Par-3 golf courses remain popular, he said, and discussed typical lighting layouts and types of equipment now being used.

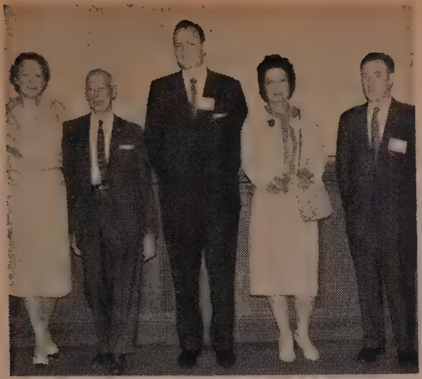
Herbert O. Spliethoff, Public Service Electric & Gas Co., Newark, N. J., declared that night lighting of playgrounds is a good investment against accidents and crimes committed under cover of darkness. Shopping centers may also be considered in part as recreational lighting, the topic covered by him, since their uses are being expanded for bowling, trampoline courts, theatres, night shopping, etc. Thus outdoor lighting is rapidly becoming an indispensable part of America at play as well as at work.

St. John Terrell, Lambertville, N. J., and New York City, and creator of the Tent Arena Theatre, gave a most interesting discussion of theatre lighting through the ages, with emphasis on theatre lighting over the past quarter century. He urged the development of new theatre and stage lighting techniques, not an ever-brighter light source for older types of outmoded units, as has been practiced over the past several years.

"Lighting for Leisure in the Residential Atmosphere" was the theme for the second technical session. William F. Little, past-president of IES, presided.

A panel of four authorities, each representing a different phase of lighting, held a symposium on "Problems in Lighting Contemporary Multiple Dwellings." Panelists were: Myrtle Fahsbender, Westinghouse Electric Corp. (light sources); Arthur Birch, Lightolier Co. (luminaires); Fred Ginbern, Office of Robert Bieu, AIA (architects); and Mrs. Ruth Senior, vice-president, Shirley Boden, Builder

**SPEAKERS** at 1962 IES Northeastern Regional Conference, West Point, N. Y., on the subject of "Spectacular Lighting for Leisure" were (l to r). Robert A. Langer, Hamel & Langer, New York City—"Lighting at the 1964 New York World's Fair;" Rollo G. Williams, Century Lighting, Inc., New York City—"Lighting of World's Fairs 1940 to Date" and Samuel G. Hibben, Montclair, N. J.—"History of World's Fair Lighting, including Reminiscences of the 1939 World's Fair, New York City."



**"PROBLEMS** in Lighting Contemporary Multiple Dwellings" was the subject for a panel discussion at the 1962 IES Northeastern Regional Conference, presided over by (second from left) William F. Little, F.I.E.S. and past-president of the Society. Panelists were (l to r): Myrtle Fahsbender, Westinghouse Lamp Division, Bloomfield, N. J.; Arthur Birch, Lightolier Co., New York City; Mrs. Ruth Senior, Shirley Boden—Builder and Developer of Middle Income Housing, New York City; and Fred Ginbern, Office of Robert Bien, AIA, New York City.

and Developer (of middle income housing).

All panelists seemed to agree that current residential lighting practice is at a minimum in multiple dwellings, and far below the industry's technology and know-how. The point was made that FHA code minimums (which they certainly are) for lighting automatically become maximum requirements and standard lighting practice. The need is for education of the public, including the builders, and to get prospects for buying or renting to demand better lighting.

Two authorities covered other aspects of "Lighting for Leisure in the Residential Atmosphere." Richard S. Smith, International Hotels Corp., discussed lighting needs and practices in hotels and motels, and Edmund Motyka, AID, an artist and designer who approaches lighting from that viewpoint, using light as an element of decorative design, discussed lighting needs and practices for restaurants and gardens.

Finally, the second session was concluded by a progress report of residential lighting, which was presented by Lillian Eddy, Large Lamp Department, General Electric Co. New York City. Color slides, a luminous panel demonstration, and a variety of new and recent residential lighting units for both interior and exterior lighting were demonstrated and discussed.

The final technical session related to the spectacular in "Lighting for Leisure." Presiding chairman for this session was Rollo G. Williams,

NOW FROM OKONITE...

*headquarters for quality cables*

OKOFLEX INDUSTRIAL CORDS

*tops for economy*

Years of experience in the manufacturing of premium quality cords of many types now pays-off for you in a new *competitively-priced* cord with superior characteristics.

Available in Types SO and SJO with neoprene jackets, or Types S and SJ with rubber jackets, new Okoflex Industrial Cords are offered in a complete range of sizes. Advantages include extra flexibility, free stripping, premium heat-resisting insulation and a reinforced jacket made to specifications which exceed U. L. and IPCEA-NEMA requirements.

New Okoflex Industrial Cords are available through leading electrical distributors. For complete information, write for Bulletin 2153, The Okonite Company, subsidiary of Kennecott Copper Corporation, Passaic, New Jersey. 6874

*where there's electrical power... there's*

OKONITE CABLE

Why can Wide-Lite mercury vapor lamp ballasts be guaranteed

⇨ for 3 years? ⇦

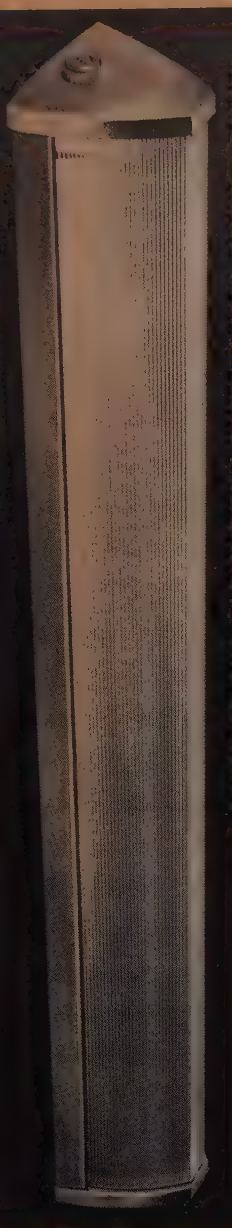
*(when other ballasts are only guaranteed for one?)*

One good reason is Mylar insulation in the transformer which helps give the Wide-Lite ballast far better resistance to heat due to overvoltage, excessive harmonics and high surrounding temperatures. Another reason is that both indoor and outdoor Wide-Lite ballasts are sealed in a special potting compound. Want more reasons? Just write!

WIDE-LITE

WIDE-LITE CORPORATION
4114 Gulf Freeway • Houston, Texas
In Canada: Wakefield Lighting Limited

FLOODLIGHTS • BALLASTS • INDOOR LUMINAIRES



APPLICATIONS: • CANOPIES • RAMPS • WASH ROOMS • SHOWER & LOCKER ROOMS • LOADING PLATFORMS • KITCHENS & REFRIGERATOR ROOMS and other wet locations.

*Ideal for protected illumination in Industrial Plants such as:* Laundries • Candy & Confectionery • Breweries • Meat & Poultry • Bakeries • Ice Cream & Dairy • Pharmaceutical • Textile • Chemical • Petroleum.

88 line by mcPhilben®

NEW 88 line weathertight protected fluorescent

*ideal for exterior, interior and wet locations where corrosive vapors and severe weather conditions prevail.*

• extruded aluminum construction • weatherproof enclosed and gasketed, dust free, bug tight, moisture proof operation • satin anodized finish • ⅛" thick prismatic arylic diffuser • choice of one or two lamp Series in 4 ft., 6 ft., 8 ft. heights • High Output, Slimline or Rapid Start • single units or continuous runs available with Clevis type brakets for pendant, ceiling and wall mounting.

Sweet's S 32a/Mc

*Contact your mcPhilben Representative or ask for complete specification data.*

mcPhilben
LIGHTING
1329 Willoughby Ave., Brooklyn 37, N.Y.

**SPEAKERS** on the "Lighting for Leisure—Sports and Entertainment" session at the 1962 IES Northeastern Regional Conference were (l to r). Herbert O. Spliethoff, Public Service Electric & Gas Co., Newark, N. J.—Lighting for Parks, Playgrounds, Shopping Center Parking Areas, and Motels; Marshall N. Waterman, Westinghouse Electric Corp., Bloomfield, N. J.—presiding chairman; Donald C. Brown, Crouse-Hinds Co., Syracuse, N. Y.—Lighting for Golf, Bowling, and Skiing; and R. L. Henderson, General Electric Co.—Lighting for Marinas and Water Sports.

Century Lighting, Inc., and chairman of the New York Section, IES.

Samuel G. Hibben, past-president world's fairs over the past couple of centuries, through the New York World's Fair of 1939. Color slides were used, and lighting features of each fair were shown and described.

Mr. Williams covered the lighting of important fairs held since 1935, up to and including the currently-running Seattle World's Fair. These included the Tokyo Fair, the Brussel's Fair, and the Moscow Fair.

The last speaker was Robert A. Langer, of the firm of Hamel & Langer, New York City lighting consultants for the 1964-65 New York World's Fair. He gave a preview glimpse of some of the lighting effects being planned, and said that many new light sources now under development will be seen at the New York Fair, possibly for the first time. Many advancements in lighting equipment and lighting application will also be used, he predicted.

### *Lighting Contest*

The IES-sponsored Applied Lighting Competition, an annual national contest, was also a highlight of the conference. Ten contestants, each a first-prize winner in a previously-held contest at the local Section or Chapter level, competed at this Regional conference for first place in each of two classifications—Residential, Class I, and Commercial/Industrial, Class II. These two winners become eligible to take their entry to the 1962 National Technical Conference, IES, to be held in Dallas, Texas, September 9-14, where they will compete for the first place on a national basis.

Three contestants competed in the Residential, Class I category. They were: Sidney Feltman, proxy for William Blitzer, Lightolier Co.—Lighting the 1962 Room for Tomorrow (first prize); W. C. Wilson, N. Y. State Electric & Gas Corp., Geneva, N. Y.—Lighting the Medallion Home of Mr. & Mrs. Norris Furman, Seneca Falls, N. Y. (second prize); and Donald J. Nevill, Niagara Mohawk Power Co., Albany, N. Y.—Lighting for Kotlow (speculatively built) Home (third prize).

In the Commercial/Industrial, Class II category, winners were: Sylvan R. Shemitz, C. S. Mersick Electric Supply, W. New Haven, Conn.—Relighting Synagogue for Congregation B'Nai Jacob, Woodbridge, Conn. (first prize); R. E. Smith, Sylvania Electric Products Inc., Salem, Mass.—Lighting a Spirits Shop, West Springfield, Mass. (second prize); John J. Neidhart and Theodore Ake, The Miller Co., Meriden, Conn.—Lighting for Work, Travel, and Relaxation (third prize).

## EASA News

Another electrical apparatus service firm has acquired its own airplane. Pixler Electric Corp., Spencer, Iowa, recently purchased a Comanche 250 aircraft, equipped with Piper Autocontrol for flying long distances with less effort. Tip tanks add to the cruising range. "We believe this plane will help us to get more business as well as to keep what we have," reports Ivan Pixler, president.

• • • •

By fortunate coincidence, a feature story about Lincoln Electric Co.'s president, James F. Lincoln, appeared in the June issue of *The Reader's Digest*, shortly before the 78-year-old industrialist delivered the keynote address at the 29th Annual EASA Convention in Chicago. The article traced the history of the manufacturing firm's successful incentive management program.

• • • •

One of the newest repair and rewind facilities in the East was opened recently when Electric Apparatus & Repair Co., Philadelphia, moved into new quarters. The high bay, one-story shop houses facili-

**INDIANAPOLIS** service shop men C. W. Reifeis (left), Moran Electric Service, Inc., and A. C. Brehob, Brehob Electric Equipment, Inc., enjoy a humorous anecdote during session break at EASA Convention in Chicago.

ties designed to handle the largest of electrical equipment. The shop has a dynamic balancing machine capable of balancing a 6,000-lb. rotating element.

• • • •

A meeting of EASA chapters in the north central states will be held in Minneapolis in mid-September. Participating groups will include the North Central, Midwestern and Wisconsin Chapters.

• • • •

New York Metropolitan Chapter won the EASA membership contest for enrolling the greatest percentage of new members during the six-month period ending on March 30. Wisconsin Chapter finished second, Southwestern Chapter third, Niagara fourth, and Rocky Mountain fifth.

• • • •

Several EASA chapters will convene on September 21 in Cleveland, Ohio, for a two-day conference. Central Ohio, Cleveland, and Great Lakes Chapters are the sponsors of the meeting, which will be held at Hotel Carter.

• • • •

EASA's two Michigan chapters, Great Lakes Chapter and Western Michigan Chapter, will hold a joint meeting in Howell, Mich., on October 15. The city is the location of the Howell Electric Motor Co., manufacturers, which plant the group will tour. Dinner will be held at the Canopy Hotel.

• • • •

W. Bruce Byrnes, president, Electric Motors, Inc., Fitchburg, Mass., was elected president of New England Chapter for 1962-63. Vice-president is John P. Lynch, Lynch Electric Co., Wrentham, Mass.; treasurer, Milton Werby, Milton Werby & Co., Boston; secretary, Hector Munro, New England Machine & Electric Co., Pawtucket, R. I.; and director, Warren Nutter, Electrical Installation Co., Cambridge, Mass.

• • • •

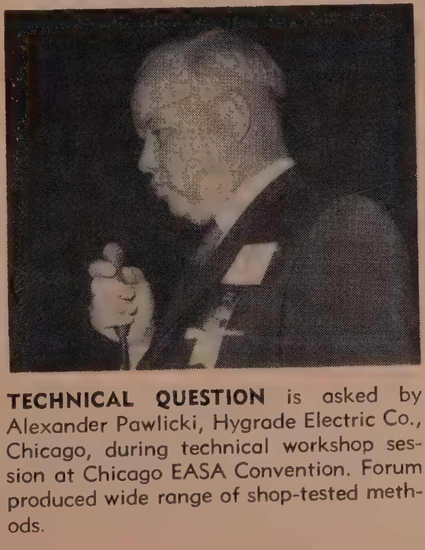
Robert C. Kaska, vice-president, Chicago Electric Co., Chicago, Ill., was named "Easan of the Month" for June by the special committee appointed for naming members for the monthly honor. Co-chairman of the EASA 29th Annual Convention, Mr. Kaska is a past-president of EASA's Chicago Chapter.

• • • •

A life membership in the Rocky Mountain Chapter was presented to Thomas Paul, Paul Electric Co., Sioux City, Iowa, on March 23. Mr. Paul, who represented EASA's Region 11 for six years on the EASA board of directors, was instrumental in organizing the chapter a few years ago.

• • • •

Business conditions in the Southwest, Southeast and Pacific Northwest generally are good, according to reports from EASA members in those areas. Some shops in Texas, Oklahoma, Arizona and New Mexico experienced increases in repair volume, George Kinard, Beaumont, Texas, reported, although profit margins were narrower. Despite smaller price differentials between repair costs and new equipment, Mr. Kinard said there is an air of optimism in his area. In the Southeast, F. E. Cook, Augusta, Ga., reported better business for the first part of 1962 over 1961. He expects rewinding prices, however, to remain at their present levels because of lower prices on new motors. In Oregon, Jack W. Calhoun, Coquille, said that the lumber industry, on which several shops in that area lean heavily for business, is up and about normal, although a number

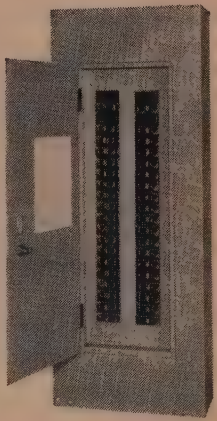


**TECHNICAL QUESTION** is asked by Alexander Pawlicki, Hygrade Electric Co., Chicago, during technical workshop session at Chicago EASA Convention. Forum produced wide range of shop-tested methods.

ACCENT ON VALUE

3 PHa-SE

load centers to 200 amp with "TWIN"* breaker flexibility



Now, a full line of 3-phase, 4-wire load centers with 12 to 42 circuits, 125, 150 and 200 amperes. Sequence phased for maximum versatility, these 1, 2 and 3-pole breakers save installation and maintenance time, reduce cost. Another G-E product development to make your job easier, more profitable.

For complete information, call your G-E Distributor today. Or write General Electric Company, Circuit Protective Devices Department, Plainville, Conn.

* Trade Mark

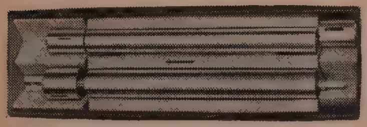
GENERAL ELECTRIC

You can SEE IT'S

BLACK HAWK

NEW hole cut extension SAW

gets pipe riser through roof overhang 30 to 90 minutes FASTER!



New from Blackhawk — a Hole Cut Extension Saw that drills, guides and cuts pipe riser holes through the roof overhang and pitched roof, *all in one operation!* Saves 30 to 90 minutes of difficult, arm-tiring work on every service entrance pipe riser you install.

Saves time and trouble on other jobs, too — cuts quickly and easily through floors, walls, ceilings, any of those hard to get at places.

Fits any standard hole saw from 1" to 4" trade size or larger. The 4" saw cuts holes for octagon boxes and even outlet holes for dryers. And the new Hole Cut Extension Saw is ideal for use with your Blackhawk Mast Kit. Available individually, or in the versatile kit, containing hole saws for 2½", 2", 1½" and 1¼" pipe risers.

Remember, when it comes to originality, versatility and quality, you can see it's Blackhawk.

See for yourself why more and more fine electricians insist on Blackhawk.

Blackhawk Industries

Blackhawk Industries
Dubuque, Iowa
*Where the new ideas come from*

**EXCHANGING IDEAS** on shop promotion during session recess at EASA Convention in Chicago are (L to R): electrical apparatus service shop executives Clarence Knutson, Knutson Electric, Fergus Falls, Minn.; and Robert D. Shakstad, Shakstad Electric & Machine Works, Sioux Falls, S. D.

of smaller operations have gone out of business, leaving the field to the big operators.

• • • •

Robert F. Joseph, a past-president of the Association of Electrical Machinery & Trades of Great Britain, and managing director, The Midland Electric Installation Co., Ltd., which operates three shops in Great Britain, was a guest at a meeting of New York Metropolitan Chapter on April 26. Mr. Joseph visited several shops in the New York area, escorted by EASA international treasurer Alex Shovan, Hawthorne, N. J.

• • • •

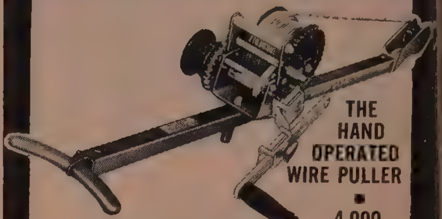
Electrical apparatus service firms are becoming more involved with the national defense effort as contracts are issued by government agencies. Hannon Electric Co., of Dayton, Ohio, is manufacturing site adaption kits for Nike missiles. In Florida, Electra-Tronics, Inc., has recently been awarded a contract to rebuild three diesel-powered generators, part of the emergency equipment for the aeronautics installation at Cape Canaveral. Electra-Tronics, Inc., with headquarters in Sarasota, operates branches in Gainesville and Cocoa. The contract also calls for inspection, maintenance and repair of the electric motors and generators at the NASA installation, according to H. H. Morgan, president.

• • • •

A Toledo motor service firm, The Kiemble Co., has expanded its territory, opening a branch office in Lima, Ohio. The firm's sales territory will cover 25 counties, an increase of eight, according to William R. Lugar, vice-president and general manager. Daniel Cassidy has been named manager of the Lima office.

PULLER TOOL
HEADQUARTERS

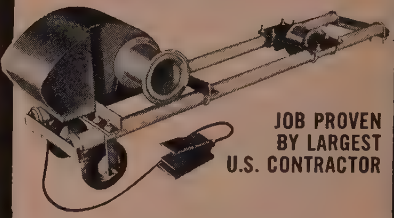
HERCULES
PORTA-PULLER



THE HAND OPERATED WIRE PULLER
•
4,000 IN USE

U. S. Pat. No. 2,990,160
Granted June 27, 1961

FI-6000 Motorized
CABLE PULLER



JOB PROVEN BY LARGEST U.S. CONTRACTOR

*IF YOU WANT THE BEST . . .*

Manufactured by:
FAIRFIELD INDUSTRIES, Inc.
PASSAIC AVENUE & PIER LANE
CALDWELL, NEW JERSEY CA 6-3645

Pat. 2632356

THIEL STAPLES ARE STANDARD SIZE BUT MADE OF HEAVIER MATERIAL

FOR LESS MONEY!

THIEL UNIVERSAL HUMP NAIL-IT
PAT. 2885169

The New Hump Drive-It Strap has a sturdy head to insure Easy-Drive without bending or pulling out. Made of No. 8 heavy wire. Zinc plating prevents rust.

ESSENTIAL FOR ELECTRICAL MEN

COPPER PLATED AVAILABLE FOR PLUMBER'S USE

WRITE FOR FREE SAMPLES

SOLD ONLY THRU LEADING ELECTRICAL WHOLESALERS

THIEL TOOL & ENGINEERING CO., INC.
1417 N. MARKET ST. LOUIS 6, MO.

# DATES AHEAD

**Western Electronic Show & Convention**—Memorial Sports Arena, Los Angeles, Calif., August 21-24.

**American Home Lighting Fixtures Month**—National promotion, September 1-30.

**Illuminating Engineering Society**—National technical conference, Statler-Hilton Hotel, Dallas, Texas, September 9-14.

**Canadian Electrical Mfrs. Assn.**—Annual meeting, Sheraton-Brock Hotel, Niagara Falls, Ont., October 3-5.

**International Assn. of Electrical Leagues**—27th annual conference, Sheraton-Chicago, Chicago, Ill., October 3-5.

**National Electrical Contractors Assn.** — Minneapolis Auditorium, Minneapolis, Minn., October 7-13.

**National Electronics Conference**—McCormick Place, Chicago, Ill., October 8-10.

**Rocky Mountain Electrical League**—Fall convention, The Broadmoor, Colorado Springs, Colorado, October 14-18.

**International Association of Electrical Inspectors** — Chapter Meetings — **Southern Section**, Tutwiler Hotel, Birmingham, Ala., October 15-17.

**Materials Handling in Canada Exposition**—Automotive Bldg., Exhibition Park, Toronto, Canada, October 15-18.

**Florida Association of Electrical Contractors**—Annual conference (no trade show), Castaway's Motel, Daytona Beach, Fla., October 18-20.

**Electrical Manufacturers Trade Show**—Indiana State Fair Grounds, Indianapolis, Ind., October 23-25.

**National Electrical Manufacturers Assn.**—Annual meeting, Shoreham Hotel, Washington, D. C., week of November 12.

**Electrical & Home Appliance Show**—Balboa Park, San Diego, Calif., November 23-28.

**Building Research Institute**—Fall conference, Mayflower Hotel, Washington, D. C., November 27-29.

**Electrical Engineering Exposition** — Sponsored by AIEE, Coliseum, New York, N. Y., January 28-31, 1963.

**16th International Heating & Air Conditioning Exposition**—Coliseum, New York, N. Y., February 11-14.

**Associated General Contractors of America**—44th annual convention, Americana Hotel, New York, N. Y., March 4-7.

**4th Southeastern Plant Engineering and Maintenance Exposition** — Merchandise Mart, Charlotte, N. C., March 5-7.

# Among the Manufacturers

## Headquarters Announcements

**Federal Pacific Electric Co.**, Newark, N. J.—Bradford J. Stimpson, commercial vice president. Also they have established a new Apparatus Div. headed by B. G. Tremblay and a new Motor Control Div. managed by Ralph J. Weiger.

**Thomas Industries Inc.**, Louisville, Ky.—Wallace H. Dunbar, vice president for finance.

**Appleton Electric Co.**, Chicago, Ill.—Lee Burian, manager of inventory control.

**Anaconda Wire and Cable Co.**, Hastings-on-Hudson, N. Y.—Alfred L. Ginty, product manager—Communications Cable.

**Young Spring & Wire Corp.**, Bowling Green, Ohio—Paul Stephens, advertising and sales promotion manager, Equipment Div.

**Electric Products Co.**, Cleveland, Ohio—James A. Barry, vice president of administration; Joseph March, vice president of manufacturing; Richard H. Pursell, vice president of sales.

**Royal Electric Corp.**, Pawtucket, R. I.—Kenneth R. MacLean, vice president of sales and marketing.

**Garcy Lighting**, Chicago, Ill.—Kenneth S. Weiss, national sales manager.

**Ward Leonard Electric Co.**, Mt. Vernon, N. Y.—G. Thomas Holbrook, general sales manager and assistant secretary.

**Sylvania Electric Products Inc.**, Salem, Mass.—John J. Steenken, manager, equipment manufacturer sales, Lighting Products Div.

**Sola Electric Co.**, Elk Grove Village, Ill.—Daniel F. McNulty, lighting sales application engineer; Frank C. Elias, manufacturing manager; Alvin S. Levine, lighting product manager.

**Basic Products Corp.**, Lake Geneva, Wis. — Herbert Pritzlaff, sales manager of original equipment manufacturer products, Hevi-Duty Electric Div.

**Tann Controls Co.**, Detroit, Mich.—John M. Andrews, director of engineering.

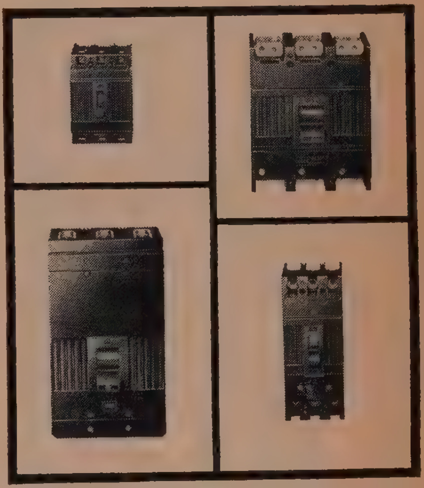
**Western Insulated Wire Co.**, Los Angeles, Calif.—Clinton G. Gerlach, chairman of the board; Edwin B. Kanner, president.

**Cutler-Hammer Inc.**, Milwaukee, Wis.—H. E. Stephenson, controller; O. J. Reak, manager of corporate services.

ACCENT ON VALUE

4 FR-ames

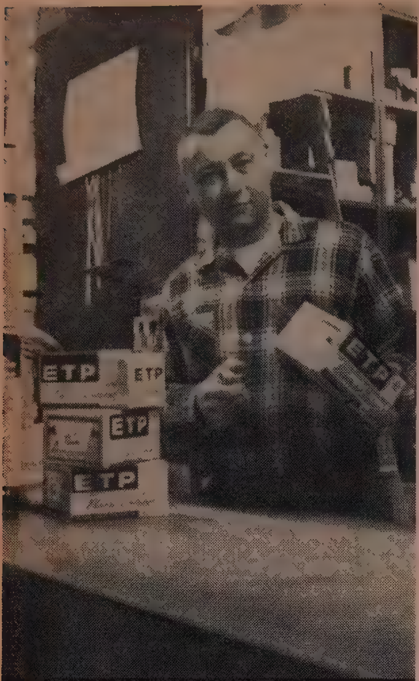
to fill your circuit breaker needs from 15 to 1000 amperes



Selection is simplified . . . only four frame sizes to choose from . . . new compact size gives increased versatility. New F 225 and J 400 lines feature ambient compensation as standard to eliminate complex derating. Front adjustable magnetic trip for ±10% accuracy at *all* settings, space savings up to 70% over old styles. Another new G-E product development to make your job easier, more profitable.

For complete information call your G-E office or Distributor today. Or write General Electric Company, Circuit Protective Devices Dept., Plainville, Conn.

GENERAL ELECTRIC



WHEN QUALITY COUNTS
WE RECOMMEND

ETP

ELECTRICAL
FITTINGS

U.L. Approved Solid One Piece Steel • U.L. Approved Concrete Tight • Pre-set, staked screws • All Sizes ½" to 2"

E.M.T. SET SCREW or INDENTER TYPE

Samples & Brochure on Request

ELECTRICAL TUBULAR PRODUCTS, INC
74-16 GRAND AVENUE, MASPETH (NYC) N. Y.
DEfender 5-8000

**Edwards Co., Inc.,** Norwalk, Conn.—Lee T. Chandler, market manager for institutional markets; Edwin A. Harris, Jr., market manager for original equipment, contract and government markets; Alfred B. Thomas, manager of product planning—all with Marketing Div.

**Thomas & Betts Co., Inc.,** Elizabeth, N. J.—Edward I. Osborne, manager of product planning research.

### Regional Appointments

#### NEW ENGLAND

**Wheeler Reflector Co., Inc.:** Donald B. Rosequist, Northeast regional sales manager.

**Mathias Klein & Sons, Inc.:** Edward Crook, district manager for New England states, Quebec and the Maritime Provinces of Canada, with headquarters in Boston.

**J. A. Weaver Co.:** Charles D. White Co., Boston, representative for Maine, Massachusetts, Rhode Island, New Hampshire and Vermont.

**Utility Transformer and Equipment Co.:** E. P. McEleney Co., Hyde Park, Mass., manufacturers agent for New England states.

#### MIDDLE ATLANTIC

**Sherman and Reilly, Inc.:** Renko Sales, Inc., Pittsburgh, representative in western Pennsylvania and West Virginia.

**J. A. Weaver Co.:** G. D. Harnett Co., Philadelphia, representative for Delaware, Maryland, Washington, D. C., eastern Pennsylvania and southern New Jersey.

**Consolidated Pipe Co. of America:** E. F. Beckley, Manhattan Sales Co., New York, N. Y., conduit sales representative for metropolitan New York, Long Island and northern New Jersey.

**Murray Mfg. Corp.:** John T. Catherwood, eastern regional sales manager supervising territory from Maine to South Carolina.

**Miller Co.:** Peter R. Steele, regional sales manager, headquartered in Philadelphia; Illuminating Div.

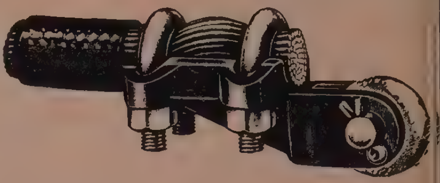
**Utility Transformer and Equipment Co.:** J. M. Donoghue and Associates, Pittsburgh, manufacturers agent for western Pennsylvania and West Virginia.

#### SOUTH ATLANTIC

**J. A. Weaver Co.:** Howard Stuphin, G. D. Harnett Co., Baltimore, representative for Maryland.

"EFFICIENCY"
Cable Strain Clamp

WITHOUT DAMAGE TO CABLE



. . . WITHSTANDS
DIRECT PULL OF 17,000 POUNDS

Efficiency Cable Strain Clamps lock cable safely and securely without possible strain or damage. "H" construction of clamps and high ridge across center of cable prevents cable from slipping. Takes cable from 1/0 to 1,500,000 c.m. Three clamp sizes cover all cable sizes. Furnished with eye or clevis, for AC or DC service.

EFFICIENCY
ELECTRIC & MFG. CO.
EAST PALESTINE, OHIO

A BLIND PERSON

CAN TELL WHEN AN "E-Z-RED" BREAKER HAS TRIPPED.
YOU CAN FEEL AND SEE THE POP UP indicator

FEWER
CALL BACKS

WRITE FOR FREE CATALOG

The WADSWORTH Electric
MFG. CO. INC.
COVINGTON KENTUCKY

**Nylok Corp.:** Jake Rudisill Associates, Inc., Charlotte, N. C., sales representative for North and South Carolina.

**Consolidated Pipe Co. of America:** J. T. Pearson Associates, North Miami Beach, conduit representative for Florida (excluding Pensacola); Walter W. Wildeman, Atlanta, Ga., conduit representative for Alabama, Georgia and eastern Tennessee.

**Mathias Klein & Sons, Inc.:** Curt Hedman, district manager covering Delaware, Maryland, Virginia, West Virginia and North Carolina, headquartered in Washington.

### EAST CENTRAL

**Nylok Corp.:** Edward F. O'Mally, Toledo, sales representative for northwestern Ohio; Carl H. Reineck & Sons, Cleveland, covering northeastern Ohio; and K & E Associates, Corinth, Miss., covering Georgia, Alabama, Mississippi and Tennessee.

**J. A. Weaver Co.:** Karl E. Eggenspiller, Louisville, representative for Kentucky.

**Appleton Electric Co.:** Michael F. Vaughan, regional manager, east central district.

**Fasco Industries, Inc.:** Robert F. DeMeyer, Cleveland district sales manager.

**Columbia Cable & Electric Corp.:** Durnal Electric Sales Co., Muncie, agent representative for Indiana.

**Consolidated Pipe Co. of America:** Clyde W. Lint, Chicago, conduit representative; Clare B. Young, Columbus, conduit representative for Ohio, West Virginia and Indiana.

**Leviton Mfg. Co., Inc.:** Rudy C. Sheppard, sales engineer, Chicago.

**Penn-Union Electric Corp.:** Jay G. Gates Co., Cincinnati, representative for southern Ohio.

**Square D Co.:** Frank G. Howard, heavy industry control sales manager at Cleveland; Electric Controller & Mfg. Div.

**Utility Transformer and Equipment Co.:** C. D. Arnold, Indianapolis, manufacturers' agent for Indiana (except NW counties) and Kentucky; Dailey Engineered Electrical Products, Chicago, for Chicago and suburban area; H. Wilson Co., Moline, for northwestern Illinois and east Iowa; Electrical Sales Agency, Jackson, for Mississippi; L. Griesser Sales Co., Cleveland, for northern Ohio; A. J. Riopelle Co., Detroit, for Michigan.

### WEST CENTRAL

**Sola Electric Co.:** Mel Foster Co., Inc., Minneapolis, representative for upper midwest.

**Consolidated Pipe Co. of America:** Arling D. Smith Co., Houston, conduit representative for Texas; Robert Nott Co., Tulsa, conduit representative for Oklahoma.

**Penn-Union Electric Corp.:** Mitchell Electrical Sales, Minneapolis, representative for Minnesota, North and South Dakota and northwestern Wisconsin.

**Utility Transformer and Equipment Co.:** Curt H. Conrad Co., Kansas City, Mo., manufacturers' agent for Kansas, Missouri and Nebraska Electrical Sales Agency, New Orleans, for Louisiana; Southland Sales Co., Houston, for Texas (except El Paso).

### WEST

**Black and Decker Mfg. Co.:** Ralph Rieder, Hawaiian sales manager.

**Jasper Blackburn Corp.:** Carlson Sales, Inc., Seattle, manufacturers' representative for Washington; Robert A. Young & Co., Glendale, representative for southern California and southern Nevada.

**Worthington Corp.:** William M. Fine, western regional sales manager; William E. Danver, San Francisco district manager.

**Sola Electric Co.:** Stephen E. Speltz, western regional sales manager with headquarters in Los Angeles.

**Penn-Union Electric Corp.:** Robert V. Scrivner, representative for Colorado, Wyoming and eastern Montana.

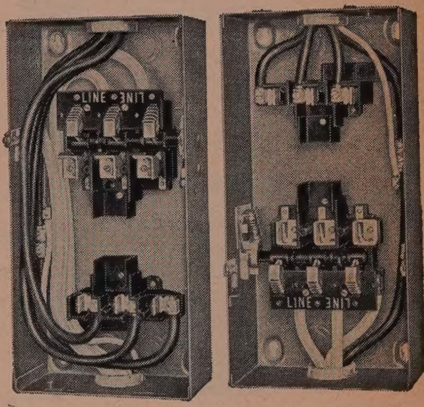
**Consolidated Pipe Co. of America:** Sterling Equipment Co., Seattle, conduit representative for Washington, Oregon, Idaho and Montana.

**Utility Transformer and Equipment Co.:** Carlson Sales Co., Seattle, manufacturers' agent for Washington, Oregon, Montana and Idaho; Electric Locator and Sales Co., Albuquerque, N. M., for New Mexico, Arizona and El Paso, Texas; Control Switches, Inc., Los Angeles, for southern California; Paul S. Everley Co., San Francisco, for northern California and Nevada.

ACCENT ON VALUE

RE-vers-IBle

Safety Switches can save you up to $30.00 on cable cost



The Old Way The G-E Way

The G-E way to wire safety switches with incoming lines at bottom saves you money on cable costs. No more wasted time with looping cables inside box. No more danger of wire abrasion. ON-OFF indication is the same as before. Available with line lugs factory installed at bottom, or for field installation. Another new G-E product development to make your job easier, more profitable.

For complete information call your G-E Distributor today. Or write General Electric Company, Circuit Protective Devices Department, Plainville, Conn.

GENERAL ELECTRIC

NEW FLEXIBLE
PERMANENT
SEALANT
RTV
102
SILICONE
RUBBER
ADHESIVE
SEALANT
READY-TO-USE
GENERAL ELECTRIC
seal metal joints, sheet work
insulate wiring and terminals
seal leaks
use as adhesive for pre-fabricated silicone rubber

For a thousand jobs, just squeeze it on and it's on to stay! No pre-mixing or priming. RTV-102 silicone rubber adheres to almost anything — glass, metal, plastics, tile, wood, silicone rubber. Sets in minutes, cures in a few hours, forms a resilient rubber that never dries out, cakes or cracks. Resists moisture, grease, weathering, many chemicals, and temperatures from —75°F to 500°F.

RTV-102 won't sag on vertical surfaces, can be smoothed over large areas, "gives" with vibration and flexing. For free evaluation sample plus technical data, write on your letterhead describing your application to Section DD870, Silicone Products Department, General Electric Company, Waterford, N.Y.

GENERAL ELECTRIC

## MOTOR BEARING MAINTENANCE

[FROM PAGE 98]

**How do you inspect motor bearings?**

When a ball bearing is removed from its housing, it should be examined for (1) contamination, dirt or corrosion, (2) excessive grease, or (3) lack of grease. Next, the bearing is cleaned with a solvent, such as carbon tetrachloride, to allow a close visual inspection. The inspection reveals the condition of the balls (or rollers), raceways and bearing housing, which often pinpoint the trouble.

If flat spots or scratches are evident on the raceway, the bearing housing may be worn or may have been improperly mounted. The presence of burned grease indicates overgreasing; powdery, carburized grease indicates lack of grease. Overheated bearing components may show a blue discoloration.

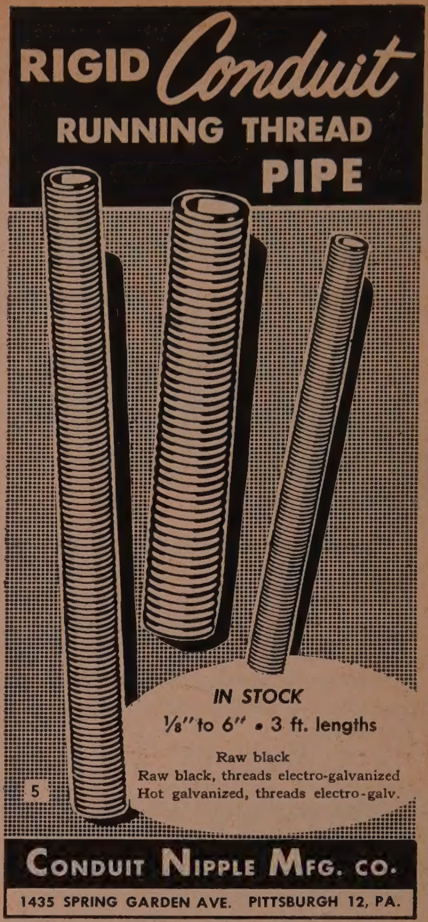
After cleaning, sleeve bearings are visually inspected for scratches and for signs of overheating. Also, the bearing fit on the motor shaft is checked. Shaft clearance should be about 0.002 in. or a little less.

**Do you have any other special provisions which improve electrical maintenance?**

Yes, in addition to our conventional paging system, we have an electronic coded-paging system, which has proved to be a worthwhile timesaver. The system consists of an encoder, transmitter and several small, pocket-size receivers, which are worn at the belt.

When a foreman is needed, the maintenance secretary dials the proper code on the encoder and operates a switch which causes the corresponding receiver to emit a high-pitched "beeping" sound. The foreman can then call the maintenance office to receive his message.

As chief electrician, I am almost constantly traveling throughout the plant checking electrical construction or repair work and answering trouble calls. Moreover, I am often required to be outside or in a remote area out of reach of regular paging. When an urgent call comes into the office, the maintenance secretary can immediately contact me through the electronic paging system. Thus I can quickly receive the message and dispatch electricians to the required job.



IN STOCK
⅛" to 6" • 3 ft. lengths
Raw black
Raw black, threads electro-galvanized
Hot galvanized, threads electro-galv.

CONDUIT NIPPLE MFG. CO.
1435 SPRING GARDEN AVE. PITTSBURGH 12, PA.

NEW SUBSCRIPTION ORDERFORM

ELECTRICAL CONSTRUCTION
& MAINTENANCE
330 West 42nd Street,
New York 36, N. Y.

Please enter my personal subscription to start as soon as possible:

☐ $3.00 enclosed for one years*

☐ Send invoice

Please Print

Name ..................................

Title or Position ..........................

Address—Home ☐ Company ☐..................

City .......................... Zone....

State ..................................

Company Name ....................

Nature of Company's Business ................

I am in charge of elec. work—Yes ☐ No ☐

Operate a motor repair shop—Yes ☐ No ☐

* *Above rates good only in U. S. Please write for rates in other countries.*

**NOW IN BOOK FORM**

***To help you solve problems of product selection—a master reference—complete, modern, illustrated in color!***

# SELECTING ELECTRICAL EQUIPMENT

**by J. F. McPartland and the Editors of Electrical Construction and Maintenance**

This book is a modern, comprehensive manual on the selection and application of equipment for electrical power, lighting, heating, signal and communication systems. The complete, original May 1962 feature section of Electrical Construction and Maintenance is now ready. Covering generic types and models of equipment, this volume discusses construction and operation of equipment as they relate to the task of selecting the right device for any job. The presentation includes NATIONAL ELECTRICAL CODE DATA and selection information based on data from NEMA STANDARDS and UNDERWRITERS' LABS.

Chapters in the book are fully and colorfully illustrated to explain quickly and clearly the many details upon which equipment selection should be based. And the Chapters are broken down according to types of equipment to facilitate ready reference.

For the first time here is a manual which organizes into practical, usable form the key product selection facts which are available otherwise only on a hit-or-miss basis.

**CONTRACTORS**—Get copies of this book for your job superintendents, foremen and estimators to help them choose the right products for specific applications quickly and effectively.

**ENGINEERS**—This book is an encyclopedia of vital, up-to-date information on the wide range of products which go into every electrical design.

**PLANT ELECTRICAL PEOPLE**—This book is a "must" for all plant electrical engineers, electrical supervisors—for anyone involved in making product selection decisions.

**ELECTRICAL INSPECTORS**—This volume contains a wealth of important information on the safety characteristics and application suitability of electrical equipment, directly correlated with NE Code and other safety standards.

**TABLE OF CONTENTS:**

**Lamps**
**Dimmers**
**Ballasts & Accessories**
**Luminaires**
**Motors**
**Motor Control**
**Electric Heating**
**Wire & Cable**
**Raceways**
**Busways**
**Switches**
**Fuses**
**Circuit Breakers**
**Panelboards & Switchboards**
**Transformers**
**Wiring Devices**
**Connectors**
**Magnetic Contactors**
**Power Sources**
**Pole Line Equipment**
**Auto-Transfer Switches**
**Signals & Communications**

USE THIS COUPON TO ORDER YOUR BOOK

**"SELECTING ELECTRICAL EQUIPMENT"**
**Electrical Construction and Maintenance**
**330 West 42nd Street, New York 36, N. Y.**

**Please send me........copy (copies) of the new book "Selecting Electrical Equipment" at $5.00 each. (10-24 copies @ $4.75 each; 25 or more copies @ $4.50 each)**

☐ **Payment enclosed.** ☐ **Please bill me.** ☐ **Bill Company.**

PLEASE PRINT

Ship to:
Name.............................................. Title......................

Company Name..................................................................

Home ☐ ..........................................................

Address — Company ☐ ..........................................................

City.................................... Zone..... State..................

Please indicate nature of Co. business.......................................... (273-076)

# Advertising In This Issue

Abolite Lighting Div., The Jones Metal Products Co. ... 46
Adam Electric Co., Frank ... 47
Advance Transformer Co ... 40
Allen-Bradley Co. ... 65, 66
• Allis-Chalmers Mfg. Co. ... 12, 13, 72, 152
• All-Steel Equipment, Inc., Raco Div. 14, 15
American Sealants Co. ... 148
Anaconda Wire & Cable Co. ... 24, 50, 51
Appleton Electric Co. ... 2
Armco Steel Corp. ... 117
Associated Research, Inc. ... 148

• Biddle Co., James G. ... 108
Black & Decker Mfg. Co. ... 110, 111, 158
• Blackhawk Industries ... 166
• Briegel Method Tool Co. ... 52
• Buchanan Electrical Products Corp. ... 114
BullDog Electric Products Division
  I-T-E Circuit Breaker Co. ... 74, 107
Burndy Corp. ... 39

Circle Wire & Cable A Subsidiary of Cerro Corp. ... 143
Conduit Nipple Mfg. Co. ... 170
• Crescent Insulated Wire & Cable Co. Inc. ... 43
• Crouse-Hinds Co. ... Fourth Cover
• Cutler-Hammer Inc. ... 36, 37, 137, 138, 139, 140

Dow Corning Corp. ... 4

Eagle Electric Mfg. Co., Inc. ... 132, 133
• Efficiency Electric & Mfg. Co. ... 168
Electrical Construction & Maintenance ... 170, 171
Electrical Tubular Products, Inc. ... 168
Electromode Div.
  Commercial Controls Corp. ... 62
Exide Industrial Marketing Div. of
  The Electric Storage Battery Co. ... 112, 113

Fairfield Industries, Inc. ... 166

G & W Electric Specialty Co. ... 17
Gamewell Co. ... 125
General Electric Co. ... 18, 19, 20, 21, 22, 23, 45, 53, 116
  Circuit Protective Devices Dept. ... 165, 167, 169
  Lamp Div. ... 64
  Silicone Products Dept. ... 170
  Wiring Device Dept. ... 8
Goodrich Chemical Co., B. F. ... 56
• Graybar Electric Co., Inc. ... 6
Gregory Industries, Inc.,
  Nelson Distributor Products ... 115
Guth Co., The Edwin F. ... Second Cover

Heinemann Electric Co. ... 126
• Hubbell Inc., Harvey ... 130

• Ideal Industries, Inc. ... 41, 135
I-T-E Circuit Breaker Co. ... 54, 55
  Walker Div. ... 109, 144

Jet Line Products Inc. ... 142
Johns-Manville ... 124
Johns-Manville, Dutch Brand Div. ... 68, 69
Jones Metal Products Co., The ... 46

Kaiser Aluminum & Chemical Corp. ... 35
Kliegel Brothers ... 134
Kohler Co. ... 102

Leviton Mfg. Co., Inc. ... 105
Lighting Products Inc. ... 44

McPhilben Lighting Co. ... 164
Minneapolis-Honeywell Regulator Co. ... 26, 27, 63
Minnesota Mining & Mfg. Co. ... 153, 154, 155
• Minerallac Electric Co. ... 162
Multi Electric Mfg. Inc. ... 136

National Tube Div. of U.S. Steel ... 48

Okonite Co. ... 163
• O.Z. Electrical Mfg. Co., Inc. ... 70, 71

Paragon Electric Co., Inc. ... 141
Pass & Seymour, Inc. ... 11
• PLM Products, Inc. ... 128
Plymouth Rubber Co., Inc. ... 123
Powder Actuated Tool Mfgrs. Institute, Inc. ... 49

Ramset Fastening System ... 67
Rawlplug Co., Inc., The ... 131
Ridge Tool Co., The ... 129

• S & C Electric Corp. ... 28, 29
• Sierra Electric Corp. ... 122
Simplex Wire & Cable Co. ... 32, 33
Sola Div. of Basic Products Corp. ... 99, 160
• Sorgel Electric Co. ... 150
Square D Co. ... Third Cover, 1, 10
Steber Div., The Pyle-National Co. ... 42
Stanley Works, The, Power Tools Div. 106
• Steel City Electric Co. ... 156
System Analyzer Corp. ... 157

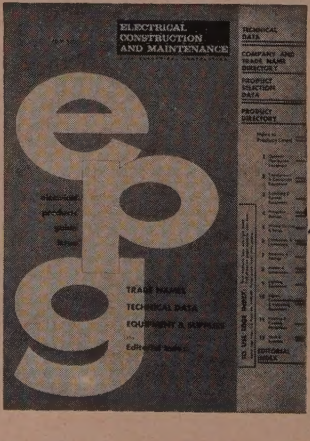
• Thiel Tool & Engineering Co., Inc. ... 166
Thomas & Betts Co. ... 25
Thompson Electric Co., The ... 127
Tomic Sales & Engineering Co. ... 149

Union Insulating Co. ... 34
U.S. Rubber, Naugatuck Chemical Div. 61
• U.S. Steel ... 48

Volkswagen of America, Inc. ... 159

Wadsworth Electric Mfg. Co., Inc., The ... 168
Wagner Electric Corp. ... 38, 104
Western Insulated Wire Co. ... 16
Westinghouse Electric Corp. ... 30, 31, 118, 146, 147
Wide-Lite Corp. ... 163
• Wiremold Co. ... 57, 58, 59, 60

Youngstown Sheet & Tube Co., The ... 100, 101



**• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE ISSUE**

**For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.**